# World report on vision

World Health Organization

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# Contents

# Foreword

In a world built on the ability to see, vision, the most dominant of our senses, is vital at every turn of our lives. The newborn depends on vision to recognize and bond with its mother; the toddler, to master balance and learn to walk; the schoolboy, to walk to school, read and learn; the young woman to participate in the workforce; and the older woman, to maintain her independence.

Yet, as this report shows, eye conditions and vision impairment are widespread, and far too often they still go untreated. Globally, *at least* 2.2 billion people have a vision impairment, and of these, at least 1 billion people have a vision impairment that could have been prevented or is yet to be addressed.

As usual, this burden is not borne equally. It weighs more heavily on low- and middle-income countries, on older people, and on rural communities. Most worrying is that projections show that global demand for eye care is set to surge in the coming years due to population growth, ageing, and changes in lifestyle.

Clearly, we have no choice but to take on this challenge. It is time to make sure that as many people as possible in all countries can see as well as current health technologies and health systems allow.

But it is important to recognize and build on the many successes in eye care of the last decades. One such success has been the WHO-endorsed SAFE strategy for trachoma elimination. Implemented in over 30 countries, it has so far resulted in eight countries eliminating trachoma as a public health problem. Other examples include public–private partnerships to provide spectacles in Pakistan, Sri Lanka, and South Africa.

The *World report on vision* sets out concrete proposals to address challenges in eye care. The key proposal is to make integrated people-centred eye care, embedded in health systems and based on strong primary health care, the care model of choice and scale it up widely.

People who need eye care must be able to receive high-quality interventions without suffering financial hardship. Including eye care in national health plans and essential packages of care is an important part of every country's journey towards universal health coverage.

WHO is committed to working with countries to improve the delivery of eye care, in particular through primary health care; to improving health information systems for eye care; and to strengthening the eye care workforce –three enabling factors for implementing integrated people-centred eye care.

But WHO cannot achieve this task alone. International organizations, donors, and the public and private sectors must work together to provide the long-term investment and management capacity to scale up integrated people-centred eye care.

Our hope is that, building on past efforts, we can successfully take on this challenge and help countries prevent eye conditions and vision impairment more effectively and provide quality eye care services according to the needs of their populations.

**Dr Tedros Adhanom Ghebreyesus**
Director-General
World Health Organization

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The *World report on vision* was drafted by Alarcos Cieza, Stuart Keel, Ivo Kocur, Megan Mccoy, and Silvio Paolo Mariotti. The Report benefited from the contributions of a number of WHO staff: Elena Altieri, Darryl Wade Barrett, Melanie Bertram, Mathieu Boniol, Paul Cantey, Laure Hermine Helene Cartillier, Shelly Chadha, Somnath Chatterji, Helene Dufays, Diana Estevez, Christine Turin Fourcade, Kaloyan Kamenov, Chapal Khasnabis, Alina Lashko, Kacem Iaych, Lindsay Lee, Christopher Mikton, Andrew Mirelman, Andreas Mueller, Patanjali Dev Nayar, Nuria Toro Polanco, Tamitza Toroyan, Hala Sakr Ali, Juan Carlos Silva, Laura Ann Sminkey, Anthony Solomon, Karin Eva Elisabet Stenberg, Gretchen Stevens, Gabriella Stern, Tamitza Toroyan.

## Contributors

### Editorial guidance

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### Additional contributors

*Authors of background papers*
Rupert Bourne, Seth Flaxman, Jennifer Gersbeck, Dominic Haslam, Mary Lou Jackson, Namita Jacob, Jill E Keeffe, Rohit Khanna, Hannah Kuper, Linda Lawrence, Moon Jeong Lee, David McDaid, Juliet Milgate, Elise Moo, Pradeep Y Ramulu, Serge Resnikoff, Bonnielin K Swenor, Hugh Taylor, Brandon Ah Tong, Johannes Trimmel, Varshini Varadaraj, Lauren E Vaughan, Sarah Wallace.

*Contributors to case studies*

Sofia Abrahamsson, Paul Cantey, Megan E. Collins, Saleh Al Harbi, Luxme Hariharan, Jade Jackson, Sam Ath Khim, Alyssa M. Kretz, Debbie Muirhead, Shadha Al Raisi, Badriya Al Rashdi, Mohamad Aziz Salowi, Peter Scanlon, Saroj M Shenoy, Neilsen De Souza, Angus Turner, Sumrana Yasmin.

*Other contributors*

Sandra Block, Tasanee Braithwaite, Simon Day, Gillian Gibbs, Peter Holland, Natalia Martín-María, Noela Prasad, Jacqui Ramke, Sulakshan Rasiah, Rory Watts, Susanne Wedner.

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# Abbreviations

| | |
|---|---|
| CDTI | community-directed treatment with ivermectin |
| CRPD | Convention on the Rights of Persons with Disabilities |
| CUSUM | cumulative sum (analysis) |
| DALYs | disability-adjusted life years |
| ECSAT | eye care service assessment tool (WHO) |
| GBD | Global Burden of Disease |
| HIS | health information system |
| ICD | International Classification of Diseases |
| ICF | International Classification of Functioning, Disability and Health |
| IPEC | integrated people-centred eye care |
| MoH | Ministry of Health |
| PHC | primary health care |
| QoL | quality of life |
| SDG | Sustainable Development Goal |
| TADDS | tool for assessment of diabetes and diabetic retinopathy (WHO) |
| UHC | universal health coverage |
| UN | United Nations |
| VEGF | vascular endothelial growth factor |
| WHA | World Health Assembly |
| WHO | World Health Organization |

# Executive summary

The global need for eye care is projected to increase dramatically in the coming decades posing a considerable challenge to health systems. Despite concerted action during the past 30 years, significant challenges remain. The *World report on vision* seeks to stimulate action in countries to address these challenges by proposing integrated people-centred eye care (IPEC) as an approach to health system strengthening that builds the foundation for service delivery to address population needs. IPEC refers to eye care services that are managed and delivered to assure a continuum of promotive, preventive, treatment and rehabilitative interventions against the spectrum of eye conditions, coordinated across the different levels and sites of care within and beyond the health sector, and according to their needs throughout the life course. IPEC will also contribute to achieving universal health coverage (UHC) and Sustainable Development Goal 3 (SDG3): "Ensure healthy lives and promote well-being for all at all ages".

## Vision, eye conditions and vision impairment

Vision, the most dominant of our senses, plays a critical role in every facet and stage of our lives. We take vision for granted, but without vision, we struggle to learn to walk, to read, to participate in school, and to work.

Vision impairment occurs when an eye condition affects the visual system and one or more of its vision functions. Vision impairment has serious consequences for the individual across the life course. Many of these consequences can, however, be mitigated by timely access to quality eye care and rehabilitation.

Eye conditions that can cause vision impairment and blindness – such as cataract, trachoma and refractive error – are, for good reasons, the main focus of prevention and other eye care strategies; nevertheless, the importance of eye conditions that do not typically cause vision impairment – such as dry eye and conjunctivitis – must not be overlooked. These conditions are frequently among the leading reasons for presentation to eye care services all countries.

## Global magnitude: eye conditions and vision impairment

Eye conditions are remarkably common. Those who live long enough will experience at least one eye condition during their lifetime. Globally, at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed. More reliable data on the met and unmet eye care needs, however, are required for planning. Also, the burden of eye conditions and vision impairment is not borne equally. The burden tends to be greater in low- and middle-income countries and underserved populations, such as women, migrants, indigenous peoples, persons with certain kinds of disability, and in rural communities. Population growth and ageing, along with behavioural and lifestyle changes, and urbanization, will dramatically increase the number of people with eye conditions, vision impairment and blindness in the coming decades.

## The costs of addressing the coverage gap

The costs of the coverage gap for unaddressed refractive errors and cataract globally are estimated to be $24.8 billion US dollars. These are the additional costs that would be required to the current health system using an immediate time horizon. This financial investment is needed immediately; it requires appropriate planning and relies on additional investment to strengthen existing health systems.

Today, millions of people live with vision impairment or blindness that could have been prevented but, unfortunately, was not. While the exact number is unknown, it is estimated that 11.9 million people globally have moderate or severe vision impairment or blindness due to glaucoma, diabetic retinopathy and trachoma that could have been prevented. The estimated costs of preventing the vision impairment in these 11.9 million would have been US$32.1 billion. This represents a significant opportunity missed in preventing the substantial personal and societal burden associated with vision impairment and blindness.

## Addressing eye conditions and vision impairment

A range of effective strategies are available to address the needs associated with eye conditions and vision impairment across the life course. These include health promotion, prevention, treatment and rehabilitation strategies, some of which are among the most feasible and cost-effective of all health care interventions to implement.

## Successes and remaining challenges in eye care

Concerted action during the past 30 years has yielded many successes: global advocacy efforts have been launched; World Health Assembly resolutions adopted; and actions plans implemented. Recent scientific and technological developments promise to further accelerate these advances. Nonetheless, progress is not keeping pace with population eye care needs. Major challenges lie ahead. Firstly, eye care needs globally will rise sharply due to changes in demographics and lifestyle. Secondly, data are often lacking and health information systems weak, thus hampering planning. Thirdly, eye care is frequently poorly integrated into health systems, for example, in national health strategic plans and health information systems; and the eye care workforce is poorly coordinated.

## Advancing UHC through eye care

Making eye care integral to UHC will contribute to reaching SDG target 3.8.[1] For this to happen quality eye care services need to be provided according to population needs and the cost of priority eye care interventions cannot expose the user to catastrophic expenditures. To facilitate the choices that countries must make when implementing UHC, WHO is developing an online data repository detailing WHO-recommended interventions and their resource implications. Part of this repository will also be a package of eye care interventions which will contribute to progressing the agenda of eye care as part of UHC forward.

## IPEC

IPEC can help address the significant eye care challenges that many countries face. IPEC adopts a health-system perspective with four strategies: (i) engaging and empowering people and communities; (ii) reorienting the model of care based on a strong primary care; (iii) coordinating services within and across sectors; and (iv) creating an enabling environment, specifically the inclusion of eye care in national health strategic plans, the integration of relevant eye care relevant data within health information systems, and the planning of the eye care workforce according to population needs.

1 SDG 3.8: "Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all."

## Conclusion and recommendations

Health systems face unprecedented challenges in meeting the current and projected eye care needs of the world's population. There is no choice but to take on these challenges. The premise of the World Report on Vision is that integrated people-centred eye care has the potential to accelerate action and meet these challenges. For this to become a reality, this report recommends five important actions:

1. Make eye care an integral part of universal health coverage.
2. Implement integrated people-centred eye care in health systems.
3. Promote high-quality implementation and health systems research complementing existing evidence for effective eye care interventions.
4. Monitor trends and evaluate progress towards implementing integrated people-centred eye care.
5. Raise awareness and engage and empower people and communities about eye care needs.

# Introduction

Everyone, if they live long enough, will experience at least one eye condition in their lifetime that will require appropriate care. Globally, at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed. Tens of millions have a severe vision impairment and could benefit from rehabilitation which they are not currently receiving. The burden of eye conditions and vision impairment is not borne equally: it is often far greater in low- and middle-income countries, among older people and in women, and in rural and disadvantaged communities.

Fortunately, thanks to concerted action taken over the past 30 years, progress has been made in many areas. In 1999, the global initiative for the elimination of avoidable blindness, "Vision 2020: the Right to Sight", intensified global advocacy efforts, strengthened national prevention of blindness programmes and supported the development of national eye care plans. This momentum was maintained by four WHA resolutions: WHA56.26 (2003); WHA59.25 (2006); WHA62.1 (2009), and WHA66.11 (2013). The 2009 and 2013 resolutions were accompanied by WHO action plans, the most recent of which, "Universal eye health: a global action plan 2014–2019", called for universal access to comprehensive eye care services and set an ambitious global target to reduce "prevalence of avoidable visual impairment by 25% by 2019". A report presented at the Seventieth WHA in May 2017 detailed the considerable progress made in implementing the 2014–2019 global action plan (resolution WHA66.4). At the same time, there has been a sharp increase in the number of population-based surveys undertaken to measure vision impairment and blindness around the world. Importantly, eye care has become an area of health care with many highly cost-effective interventions for health promotion, prevention, treatment and rehabilitation to address the entire range of needs associated with eye conditions and vision impairment across the life course.

Yet significant challenges remain. Chief among these are inequalities in coverage; addressing unmet needs and ensuring services are planned and provided according to population needs; uneven quality of eye care services; workforce shortages; fragmented services that are poorly integrated into health systems; gaps in data, particularly related to monitoring trends and evaluating progress; and lack of implementation, impact and health systems research related to eye care. In addition, population ageing (a third more people predicted to be aged over 60 years by 2030), coupled with lifestyle changes (less time spent outdoors, and increasingly sedentary life-styles and

unhealthy eating habits), are causing the number of people with eye conditions and vision impairment to increase. Available data provide an incomplete picture of the met and unmet needs for eye care; nonetheless, the health systems of countries face considerable challenges. Such challenges include addressing the unmet eye care needs, continuing to provide eye care for those whose needs are being met, and preparing for a projected consistent increase in numbers of those needing eye care.

The *World report on vision*, building on achievements to date, aims to galvanize action to address these challenges. Building on WHO's existing Framework on integrated people-centred health services, integrated people-centred eye care (IPEC) is the key proposal of the report. IPEC is defined as services that are managed and delivered so that people receive a continuum of health promotive, preventive, treatment and rehabilitative interventions to address the full spectrum of eye conditions according to their needs, coordinated across the different levels and sites of care within and beyond the health sector, that adopts people's perspectives as participants and beneficiaries of these services, throughout their life course. IPEC also has the potential to contribute to the progress towards UHC in relation to eye care and to achieving SDG 3: "Ensure healthy lives and promote well-being for all at all ages".

The *World report on vision* is directed at policy-makers, practitioners, public health specialists, researchers, and academics, as well as ministries of health, civil society, and development agencies.

## Aims

The overall aims of the report are:

- To raise awareness of the global magnitude and impact of eye conditions and vision impairment and the need to address gaps in data, particularly regarding met and unmet eye care needs;
- To draw attention to effective strategies to respond to eye care needs;
- To take stock of progress, and identify the main challenges facing the field of eye care;
- To emphasize the need for making eye care an integral part of UHC;
- To make the case for IPEC as the way forward;
- To make recommendations for action to be implemented by all countries to improve eye care.

## Scope

This report makes the case that integrated people-centred eye care is the care model of choice and can help meet the challenges faced. *Chapter 1* highlights the critical importance of vision; describes eye conditions that can cause vision impairment and those that typically do not; reviews the main risk factors for eye conditions; defines vision impairment and disability; and explores the impact of vision impairment. *Chapter 2* provides an overview of the global magnitude of eye conditions and vision impairment and their distribution. *Chapter 3* presents effective promotive preventive, treatment, and rehabilitative strategies to address eye care needs across the life course. *Chapter 4* starts by taking stock of global advocacy efforts to date, the progress made in addressing specific eye conditions and vision impairment, and recent scientific and technological advances; it then identifies the remaining challenges facing the field. *Chapter 5* describes how making eye care an integral part of universal health care (including developing a package of eye care interventions) can help address some of the challenges faced by countries. *Chapter 6* presents IPEC and explains the need for engaging and empowering people and communities, reorienting the model of care based on a strong primary care and the need for coordinating services within and across sectors; and creating an enabling environment.

The report ends with five recommendations for action that can be implemented by all countries to improve eye care.

## Moving forward

It is the intention of WHO and all involved in the preparation of the *World report on vision,* that the report will lead to greater awareness and increased political will and investment to implement its recommendations for action to strengthen eye care so that the field can meet the current and future challenges it faces.

# Chapter 1

# Vision, eye conditions and vision impairment

In a global society built on the ability to see, vision impairment has far-reaching consequences for individuals, their families and carers.

While some eye conditions cause vision impairment, many do not and yet can still lead to personal and financial hardships because of the treatment needs associated to them.

Vision impairment occurs when an eye condition affects the visual system and one or more of its vision functions. A person who wears spectacles or contact lenses to compensate for their vision impairment, still has a vision impairment.

“Disability” refers to the impairments, limitations and restrictions that a person with an eye condition faces in the course of interacting with her or his environment – physical, social, or attitudinal.

Timely access to quality care has a major influence on the impact of eye conditions.

# Vision

In a global society built on the ability to see, vision plays a critical role in every facet and stage of life.

Vision is the most dominant of the five senses and plays a crucial role in every facet of our lives. It is integral to interpersonal and social interactions in face-to-face communication where information is conveyed through non-verbal cues such as gestures and facial expressions *(1, 2)*.

**Vision plays a critical role in every facet and stage of life.**

Globally, societies are built on the ability to see. Towns and cities, economies, education systems, sports, media and many other aspects of contemporary life are organized around sight. Thus, vision contributes towards everyday activities and enables people to prosper at every stage of life.

From the moment of birth, vision is critical to child development. For infants, visually recognizing and responding to parents, family members, and caregivers facilitates cognitive and social development and the growth of motor skills, coordination and balance *(3)*.

From early childhood to adolescence, vision enables ready access to educational materials and is pivotal to educational attainment *(4, 5)*. Vision supports the development of social skills to foster friendships, strengthen self-esteem and maintain well-being *(6)*. It is also important for participation in sports and social activities that are essential to physical development, mental and physical health, personal identity and socialization *(7)*.

In adulthood, vision facilitates participation in the workforce, contributing to economic benefits and a sense of identity *(8, 9)*. It also contributes towards the enjoyment of many other areas of life that are often designed around the ability to see, such as sports or cultural activities.

Later in life, vision helps with maintaining social contact and independence *(10-12)* and facilitates the management of other health conditions *(13-15)*. Vision also helps to sustain mental health and levels of well-being, both of which are higher among those with good vision *(16-18)*.

# Eye conditions

While some eye conditions cause vision impairment, many typically do not yet can still lead to personal and financial hardships.

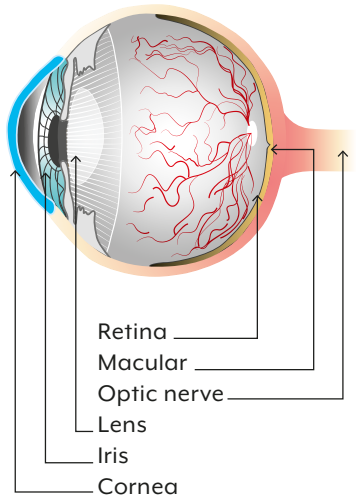
Eye conditions encompass a large and diverse range of morbidities that affect different components of the visual system and visual function (Box 1.1). Given their range, classifying eye conditions is a challenge; one way is to distinguish conditions that do not typically cause vision impairment from those that can (Tables 1.1 and 1.2).

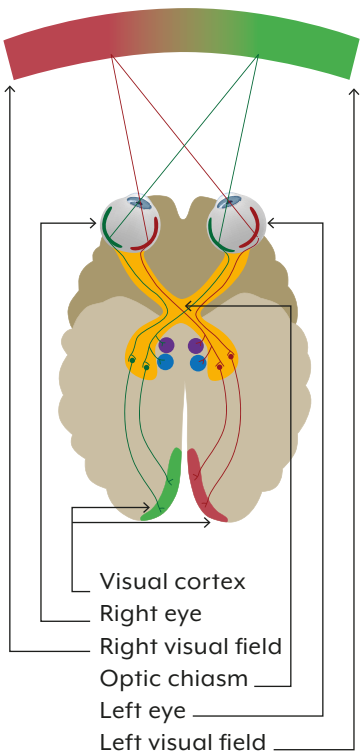
**Some eye conditions cause vision impairment, many do not.**

The importance of eye conditions that typically do not cause vision impairment should not be understated. These conditions can be troublesome and painful, and are frequently among the leading reasons for presentation to eye care services in all countries. For example, published data from the emergency departments of major health facilities in the high-income countries of Australia, the United States of America and Saudi Arabia reveal that conjunctivitis, a generally benign and self-limiting condition, is the most common reason for patient presentation *(19-22)*. Data gathered from health facilities in low- and middle-income countries show similar trends, with eye conditions that are typically non-vision-threatening, such as conjunctivitis, lid abnormalities, pterygium and dry eye, consistently ranked among the top reasons for clinic attendance *(23-27)*.

Eye conditions that can cause vision impairment and blindness are, with good reason, the main focus of prevention and intervention strategies. Notable, however, is that a considerable proportion of people with eye conditions in this category who receive timely diagnosis and treatment will not develop vision impairment or blindness. For example, of the estimated 196 million people globally with age-related macular degeneration *(28)*, 10.4 million (5.3%) have moderate or severe distance vision impairment or blindness from more severe forms of the condition *(29)*. Similarly, an estimated 64 million people globally have glaucoma *(30)*, of which 6.9 million (10.9%) only are reported to have moderate or severe distance vision impairment or blindness resulting from more severe forms of the condition *(29)*.

Also worthy of mention, is that certain conditions that do not typically cause vision impairment (as described in Table 1.1), may do so, if left untreated. For example, untreated cases of a form of conjunctivitis caused by gonococcal infection can result in vision impairment when bacteria penetrates the cornea causing corneal ulceration and scarring *(31)*. This emphasizes the importance of early identification and timely treatment for all eye conditions (as discussed in Chapter 3).




## Box 1.1 The visual system and vision functions

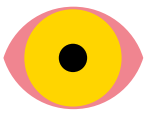
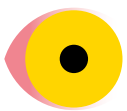
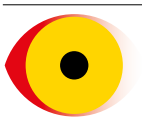
*Visual system*

The visual system encompasses the eyes, optic nerves, and pathways to and between different structures in the brain. Structures at the front of the eye (the cornea and lens) focus light entering the eye onto the retina. In the retina, light is converted into nerve impulses which travel through the optic nerves and pathways to a specific part of the brain known as the visual cortex. These impulses are then transmitted to many other parts of the brain where they integrate with other inputs (such as from hearing or memory) to enable a person to understand the surrounding environment and respond accordingly.

*Vision functions*

The visual system enables the vision functions which support a variety of activities and occupations:

- Visual acuity is the ability to see details clearly, regardless of the distance of the object.
  - Distance visual acuity is used in many everyday situations, such as reading a blackboard, signposts or bus numbers, or when recognizing people across a room. It is important for many occupations and recreational activities, such as playing sports.
  - Near visual acuity is important for all near tasks, such as reading and writing. It is also used in many occupations and recreational activities, such as tea picking, sorting grains and using mobile phones and computers.
- Colour vision has a very practical role, allowing differentiation of objects of a similar size and shape, such as medication; it is also important for occupations such as electrical work, aviation and fashion.
- Stereopsis/binocular vision (depth perception) allows judgement of distances and the speed of approaching objects. It is important for many near tasks, such as pouring liquids into a glass or threading a needle.
- Contrast sensitivity refers to the ability to distinguish an object from its background, which may often involve distinguishing shades of grey. It is especially important in situations of low light, such as driving at night.
- Vision in the peripheral visual fields, as well as the central part of the visual field, assists in moving around safely, by detecting obstacles and movement in a person's side vision. It is important for safe driving and for many occupations and sports.

| | Common eye conditions that do not typically cause vision impairment (Table 1.1) |
|---|---|
|  | **Blepharitis**<br>Inflammation of the eyelids near the base of the eyelashes characterized by redness and irritation of the eye and eyelid. |
|  | **Chalazion and hordeolum (stye)**<br>Common eyelid disorders resulting from a blocked gland or localized infection that can cause pain. |
|  | **Conjunctivitis**<br>Inflammation of the conjunctiva (the clear membrane lining the inside of the eyelids and covers the white part of the eye) most commonly caused by allergy or infection. |
|  | **Dry eye**<br>Due to an inadequate tear production that can result in irritation and blurred vision. |
|  | **Pterygium and pinguecula**<br>Abnormal growths on the conjunctiva that can cause pain. In advanced cases, pterygium can encroach on the cornea and cause vision loss. |
|  | **Subconjunctival haemorrhage**<br>Broken blood vessels underneath the conjunctiva. |

Common eye conditions that can cause vision impairment including blindness (Table 1.2)

**Age-related macular degeneration**

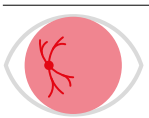
Damage to the central part of the retina responsible for detailed vision leads to dark patches, shadows or distortion of the central vision. The risk of developing macular degeneration increases with age.

**Cataract**

Cloudiness in the lens of the eye, leading to increasingly blurred vision. The risk of developing cataract increases with age.

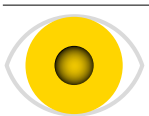
**Corneal opacity**

A group of conditions causing the cornea to become scarred or cloudy. Opacity is most commonly caused by injury, infection or vitamin A deficiency in children.



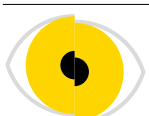
**Diabetic retinopathy**

Damage to blood vessels in the retina which become leaky or blocked. Vision loss most commonly occurs due to swelling in the central part of the retina which can lead to vision impairment. Abnormal blood vessels can also grow from the retina, which can bleed or cause scarring of the retina and blindness.



**Glaucoma**

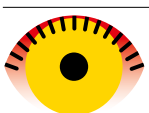
Progressive damage to the optic nerve. Initially, loss of vision occurs in the periphery and can progress to severe vision impairment (this is known as open angle glaucoma, the most common type and the type generally referred to in this report).



**Refractive error**

Due to an abnormal shape or length of the eye ball; light does not focus on the retina resulting in blurred vision. There are several types of refractive error; those most commonly referred to in this report are:

- *Myopia* – difficulty seeing distant objects (near-sightedness).
- *Presbyopia* – difficulty seeing objects at near distance with increasing age (i.e. after 40 years of age).



**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.

## Risk factors for, and causes of, eye conditions

Risk factors for, and causes of, eye conditions include ageing, genetics, lifestyle exposure and behaviours, infections, and various health conditions. Many eye conditions are multifactorial in origin.

Many risk factors increase the likelihood of developing, or contributing to the progression of, an eye condition. These include ageing, lifestyle exposure and behaviours, infections, and a range of health conditions.

Ageing is the primary risk factor for many eye conditions. The prevalence of presbyopia, cataract, glaucoma and age-related macular degeneration increase sharply with age *(28, 30, 32, 33)*. Genetics also play a role in the development of some eye conditions including glaucoma, refractive error and retinal degenerations such as retinitis pigmentosa *(34-36)*. Ethnicity *(30)* is an example of another non-modifiable risk factor that is related to a greater risk of developing some eye conditions.

**Ageing is the primary risk factor for many eye conditions.**

Lifestyle exposures or behaviours are also linked to many eye conditions. Smoking is the primary modifiable risk factor for age-related macular degeneration *(37)* and plays a part in the development of cataract *(38)*. Nutrition may also play an important role in eye conditions. For example, vitamin A deficiency, resulting from chronic malnutrition in children, can cause corneal opacity *(39)*. Additionally, occupations and recreational activities, such as farming or mining and contact sports, are linked consistently to greater risk of ocular injury *(40)*.

Ocular infections from bacterial, viral or other microbiological agents can affect the conjunctiva, cornea, eyelids and, more rarely, the retina and optic nerve; conjunctivitis is the most common of these *(41)*. Trachoma, the leading infectious cause of blindness worldwide, is caused by the bacterium *chlamydia trachomatis (42)*. Environmental risk factors, including hygiene, sanitation and access to water, are also important in influencing the transmission of the trachoma bacterium *(43)*. Other infections that can cause vision impairment and blindness include measles *(44)*, *onchocera volvulus (45)* and the *toxoplasma gondii* parasites *(46)*, to name a few.

Certain health conditions may lead to a range of ocular manifestations; these include, but are not limited to, diabetes *(47)*, rheumatoid arthritis *(48)*, multiple sclerosis *(49)* and pre-term birth *(50).* Additionally, some medications increase the susceptibility of developing certain eye conditions; the long-term use of steroids, for example, increases the risk of developing cataract *(51)* and glaucoma *(52)*.

The origins of many eye conditions are multifactorial, with a range of risk factors interacting to increase both the susceptibility to, and the progression of, a condition. Diabetes duration, high haemoglobin A1c, and high blood pressure, for example, are important risk factors for diabetic retinopathy *(53)*. Another example is myopia, where an

interplay between genetic and environmental risk factors, including intensive near vision activity (as a risk factor) and longer time spent outdoors (as a protective factor), may play an important role in the onset and progression of the condition *(36)*.

Access to quality eye care is a significant factor in the risk of progression of eye conditions and treatment outcomes *(54-57)*. Effective interventions are available to prevent, treat, and manage most major eye conditions (further details are provided in Chapter 3). It is important to note that although some conditions, such as trachoma, can be prevented, others, such as glaucoma or cataract, cannot, but can be treated to reduce the risk of vision impairment.

# Vision impairment

Vision impairment occurs when an eye condition affects the visual system and one or more of its vision functions.

According to the International Classification of Functioning, Disability and Health (ICF), an "Impairment" is a general term used to describe a *problem* in the function or structure of a person's body due to a health condition *(58).* This definition is compatible with the International Classification of Diseases 11th Edition (ICD 11) *(59)*. Accordingly, a vision impairment results when an eye condition affects the visual system and one or more of its vision functions.

**Vision impairment occurs when an eye condition affects the visual system and one or more of its vision functions.**

Typically, population-based surveys measure visual impairment using exclusively visual acuity, with severity categorized as mild, moderate or severe *distance* vision impairment or blindness, and *near* vision impairment (Box 1.2). However, in the clinical setting, other visual functions are also often assessed, such as a person's field of vision, contrast sensitivity and colour vision.

Box 1.3 provides details of the evolution of the concept and definition of vision impairment during the past few decades.

It is important to note that, as described in Box 1.4, most published data on "vision impairment" are based on measures of "presenting visual acuity" and do not include individuals whose vision impairment is compensated for with spectacles or contact lenses. For this reason, there is no global estimate of the total number of people with vision impairment (see Chapter 2). Previously, it was appropriate for the eye care field to rely on "presenting visual acuity" because it provided an estimate of the unmet eye care needs. However, to plan services and monitor progress effectively, it is important to have information on both the met and the unmet needs of eye care. This is particularly important given that individuals with refractive errors have an ongoing need for eye care services.

**Box 1.2 Visual acuity measurement, and classification table for the severity of visual impairment**

*Visual acuity*

Visual acuity is a simple, non-invasive measure of the visual system's ability to discriminate two high contrast points in space.

*Distance visual acuity* is commonly assessed using a vision chart at a fixed distance (commonly 6 metres (or 20 feet) *(55)*. 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.

*Near visual acuity* is measured according to the smallest print size that a person can discern at a given test distance *(60)*. In population surveys, near visual impairment is commonly classified as a near visual acuity less than N6 or m 0.8 at 40 centimetres *(61)*, where N refers to print size based upon the point system as used in the printing business and 6 is a font size equivalent to newspaper print.

*Classification of severity of vision impairment based on visual acuity in the better eye*

| **Category** | **Visual acuity in the better eye** | |
|---|---|---|
| | **Worse than:** | **Equal to or better than:** |
| Mild vision impairment  | 6/12 | 6/18 |
| Moderate vision impairment  | 6/18 | 6/60 |
| Severe vision impairment  | 6/60 | 3/60 |
| Blindness  | 3/60 | |
| Near vision impairment  | N6 or M 0.8 at 40cm | |

Typically, epidemiological surveys measure the degree of visual impairment and blindness according to the above classification table using visual acuity *(61)*. Severe visual impairment and blindness are also categorized according to the degree of constriction of the central visual field in the better eye to less than 20 degrees or 10 degrees, respectively *(62, 63)*.

### Box 1.3. Evolution of the classification of vision impairment

The classification of vision impairment using visual acuity has changed over time:

- In 1972, a WHO study group established categories of vision impairment and blindness in order to facilitate the collection of population-based data in a uniform format. At that time, the prevalence of vision impairment was calculated based on best-corrected (i.e. tested with spectacles if usually worn, or a pinhole) in the better eye. The cut-off for categorizing vision impairment was a best-corrected visual acuity of less than 6/18, while blindness was categorized as a best-corrected visual acuity of less than 3/60.
- In 2010, the classification of vision impairment was updated based on the premise that (i) the use of "best corrected" visual acuity overlooks a large proportion of people with vision impairment due to uncorrected refractive error; and (ii) there was no distinction between those who have varying levels of blindness (e.g. no perception of light and those that have light perception but still measure less than 3/60 in the better eye). As a result, "best-corrected" visual acuity was replaced with "presenting" visual acuity (i.e. the visual acuity of a person as she or he presents to the examination); blindness was further subcategorized into three distinct levels of severity.
- Recently, some investigators have adopted a more stringent cut-off for categorizing vision impairment (i.e. a visual acuity of less than 6/12 in the better eye) in recognition of a growing body of evidence that milder reductions in visual acuity impacts every day functioning of individuals.

### Box 1.4 Changing the way vision impairment is reported

The measure of vision impairment typically reported in population-based surveys is based on visual acuity in the better eye of a person as presented in examination. If spectacles or contact lenses are worn – for example to compensate for vision impairment caused by a refractive error – visual acuity is measured with the person wearing them; thus they will be categorized as not having a vision impairment.

Measuring "presenting visual acuity" is useful for estimating the number of people who need eye care, including refractive error correction, cataract surgery or rehabilitation. However, it is not appropriate for calculating the total number of people with vision impairment. For this reason, the term "presenting distance vision impairment" is used in this report, but only when describing previous published literature that defines vision impairment based on the measure of "presenting visual acuity".

To calculate the total number of people with vision impairment, visual acuity needs to be measured and reported without spectacles or contact lenses.

Much of the published literature does not report on unilateral vision impairment, with most opting to focus solely on bilateral vision impairment. However, a (smaller) body of literature *(64)* shows that unilateral vision impairment impacts on visual functions, including stereopsis (depth perception) *(64)*. As with bilateral vision impairment, persons with unilateral vision impairment are also more prone to issues related to safety (e.g. falls) and maintaining independent living *(65)*. Further studies report that patients who undergo cataract surgery in both eyes have more improved functioning than patients who undergo surgery in one eye only *(66)*.

Vision impairment can worsen as an underlying eye condition progresses. Nevertheless, effective interventions are available for most eye conditions that lead to vision impairment. These include:

a) Refractive errors, the most common cause of vision impairment, can be fully compensated for with the use of spectacles or contact lenses, or corrected by laser surgery.

b) Vision impairment caused by some age-related conditions, such as glaucoma, have no cure and cannot be corrected. However, effective treatments and surgical interventions are available which can either delay or prevent progression.

c) Vision impairment caused by other age-related conditions, such as cataract, can be corrected through surgical interventions. Given that cataracts worsen over time, people left untreated will experience increasingly severe vision impairment which can lead to blindness and significant limitations in their overall functioning.

In cases where vision impairment or blindness cannot be prevented – such as advanced age-related macular degeneration (particularly the "dry" form of the condition) – rehabilitation services are required to optimize functioning in everyday life.

The examples described above underscore two important issues: first, effective interventions exist for the vast majority of eye conditions that can cause vision impairment; and secondly, access to interventions can significantly reduce, or eliminate, vision impairment or its associated limitations in functioning. The range of available interventions are described in more detail in Chapter 3.

## Vision impairment and disability

Disability refers to the impairments, limitations and restrictions that a person with an eye condition faces in the course of interacting with her or his environment – physical, social, or attitudinal.

In the ICF, disability encompasses impairments, the difficulties a person may have in carrying out activities such as self-care, and the problems they experience in involvement in everyday life situations, such as going to school or work *(67)*.[1] According to the ICF, the disability experienced is determined not only by the eye condition, but also by the physical, social and attitudinal environment in which the person lives, and the possibility of accessing quality eye care, assistive products (such as spectacles), and rehabilitation services.

**Disability refers to the impairments, limitations and restrictions that a person with an eye condition faces in the course of interacting with her or his environment – physical, social, or attitudinal.**

A person with an eye condition experiencing vision impairment or blindness and facing environmental barriers, such as not having access to eye care services and assistive products, will likely experience far greater limitations in everyday functioning, and thus higher degrees of disability.

Addressing the eye care needs of people with vision impairment or blindness, including rehabilitation, is of utmost importance to ensure optimal everyday functioning. In addition, an urgent need is required for a broad societal response to fulfil the rights of persons with long-term impairments (as required by the Convention on the Rights of Persons with Disabilities (CRPD)), so that people with severe vision impairment or blindness participate in society on an equal basis with others.

## Consequences for individuals

Vision impairment has serious consequences across the life-course, many of which can be mitigated by timely access to quality eye care and rehabilitation.

Not meeting the needs, or fulfilling the rights, of people with vision impairment, including blindness, has wide-reaching consequences. Existing literature shows that insufficient access to eye care and rehabilitation and other support services can substantially increase the burden of vision impairment and degree of disability at every stage of life *(68, 69)*.

Young children with early onset severe impairment can experience delayed motor, language, emotional, social and cognitive development *(70)*, with lifelong consequences. School-age children with vision impairment can also experience lower levels of educational achievement *(71, 72)* and self-esteem than their normally-sighted peers *(73)*.

1 This is consistent with the understanding of disability in the United Nations Convention on the Rights of Persons with Disabilities.

Studies have consistently established that vision impairment severely impacts quality of life (QoL) among adult populations *(10, 65, 74-76)* and a large proportion of the population rank blindness as among their most feared ailment, often more so than conditions such as cancer *(77, 78)*. Adults with vision impairment often have lower rates of workforce participation and productivity *(79, 80)* and higher rates of depression and anxiety *(16-18)* than the general population. In the case of older adults, vision impairment can contribute to social isolation *(81-83)*, difficulty walking *(84)*, a higher risk of falls and fractures, particularly hip fractures *(85-91)* and a greater likelihood of early entry into nursing or care homes *(92-94)*. It may also compound other challenges such as limited mobility or cognitive decline *(95, 96)*.

**Vision impairment has serious consequences across the life-course, many of which can be mitigated by timely access to quality eye care and rehabilitation.**

In general terms, people with severe vision impairment experience higher rates of violence and abuse, including bullying and sexual violence *(97-100)*; are more likely to be involved in a motor vehicle accident *(101, 102)*; and can find it more difficult to manage other health conditions, for example being unable to read labels on medication *(13-15)*.

While the number of people with severe vision impairments is substantial, the overwhelming majority have vision impairments that are mild or moderate *(61)*. Yet very little is known about the consequences of mild and moderate vision impairment on, for example, infant and child development, educational achievement, workforce participation, and productivity. Nonetheless, it is evident that, without access to quality eye care and provision of proper spectacles or contact lenses, mild or moderate vision impairment can affect significantly an individual's cognitive, social and economic well-being *(103)*.

### Impact on family members and carers

Support from family members, friends, and other carers is often crucial but can have an adverse impact on the carer.

Family members, friends and other carers are often responsible for providing physical, emotional and social support for those with severe vision impairment *(104)*. Examples of such support include accompanying children to school; assistance with activities of daily living (e.g. shopping, cooking, cleaning); financial help to buy assistive devices to improve their functioning in the home, to increase their attendance at medical and/or rehabilitation services, to pay for external carers; and emotional support during difficult times *(104, 105)*.

Evidence suggests that support from family members has a positive influence on those with vision impairment and can lead to improved adaptation to vision impairment, greater life satisfaction *(106, 107)*, fewer depressive symptoms *(106)* and improved uptake of rehabilitative services and assistive products *(108)*. However, providing such support may have detrimental consequences on the caregiver

and lead to an increased risk of physical and mental health conditions *(109),* such as anxiety *(110)* and depression *(111)*. This is more likely to occur when the caregiver has difficulty balancing their own needs with those of the family member, or when money is short *(104)*.

Over and above the support of family, friends and other care givers, a societal response is essential. Member States need to recognize their obligations to fulfil all the requirements contained in the 31 articles of the CRPD.

### Impact on society

**Vision impairment poses an enormous global financial burden due to productivity loss.**

The 2017 Global Burden of Disease (GBD) Study ranked vision impairment, including blindness, the third cause among all impairments for years lived with disability *(112)*. In addition, the societal burden of vision impairment and blindness is substantial given its impact on employment, QoL and the related caretaking requirements.

Vision impairment also poses an enormous global financial burden as demonstrated by previous research that has estimated costs of productivity loss *(79, 80, 113, 114)*. For example, a recent study among nine countries estimated that the annual cost of moderate to severe vision impairment ranged from US$ 0.1 billion in Honduras to as high as US$ 16.5 billion in the United States of America *(113)*, while annual global costs of productivity losses associated with vision impairment from uncorrected myopia and presbyopia alone were estimated to be US$ 244 billion and US$ 25.4 billion, respectively *(79, 80)*. Of particular note, the economic burden of uncorrected myopia in the regions of East Asia, South Asia and South-East Asia were reported to be more than twice that of other regions and equivalent to more than 1% of gross domestic product *(80)*.

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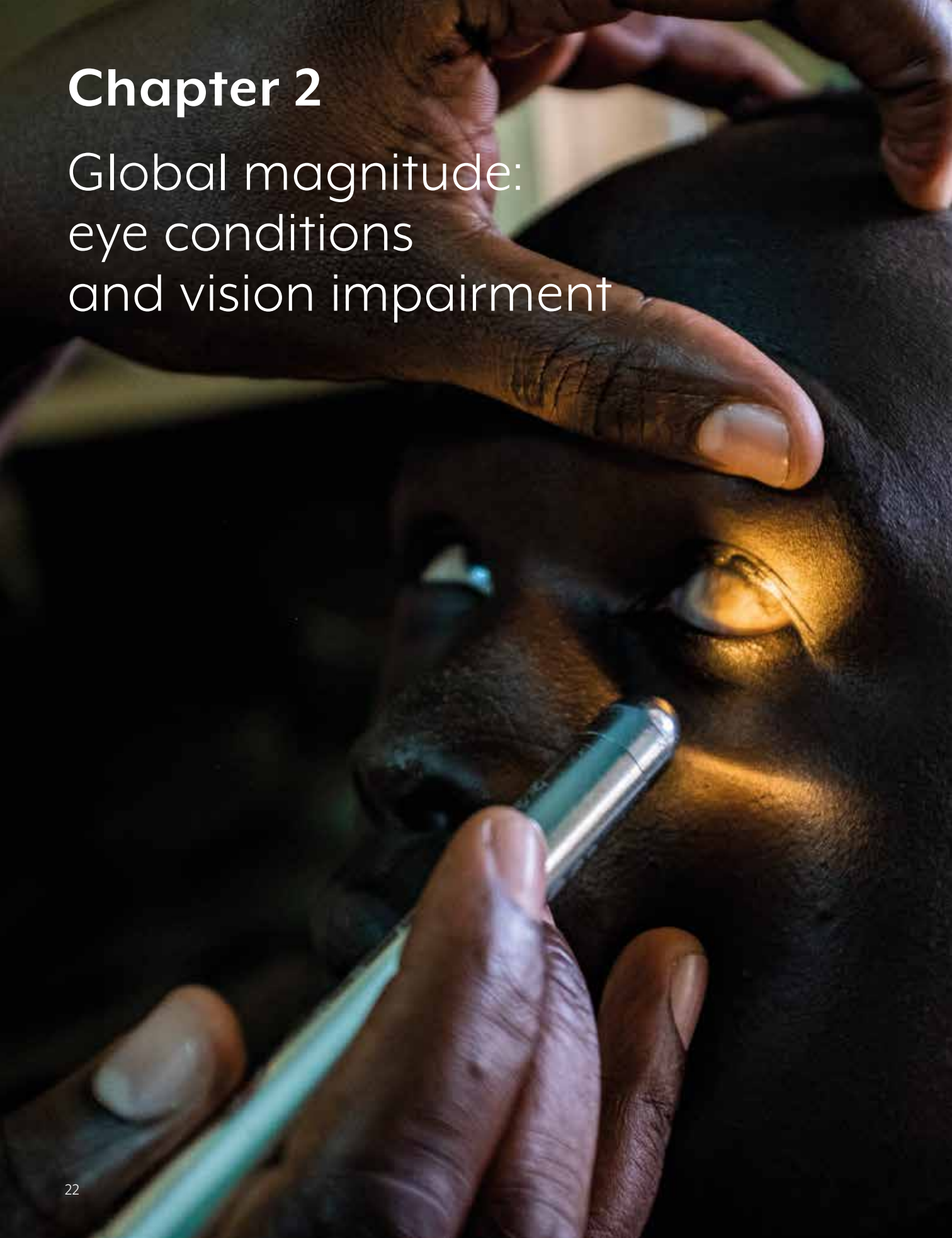


# Chapter 2

# Global magnitude: eye conditions and vision impairment

Globally, at least 2.2 billion people have a vision impairment, of whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed.

Eye conditions are remarkably common. Yet accurate estimates of the global magnitude of eye conditions are lacking.

The burden of most eye conditions and vision impairment is not borne equally. Inadequate access to eye care is a major cause of the uneven distribution.

An improved understanding of the magnitude of eye care needs that are currently being met by the health system is critical for effective planning.

Eye care is a good investment. Preventing eye conditions and vision impairment will lead to improved productivity and reduce informal and intangible costs.

In the coming decades, if the projected increase in older people is not met with increased access to eye care services, there will be a substantial increase in the number of people with vision impairment and blindness.

# Global magnitude: eye conditions

Eye conditions are remarkably common. Yet estimates of the global magnitude of some eye conditions are lacking.

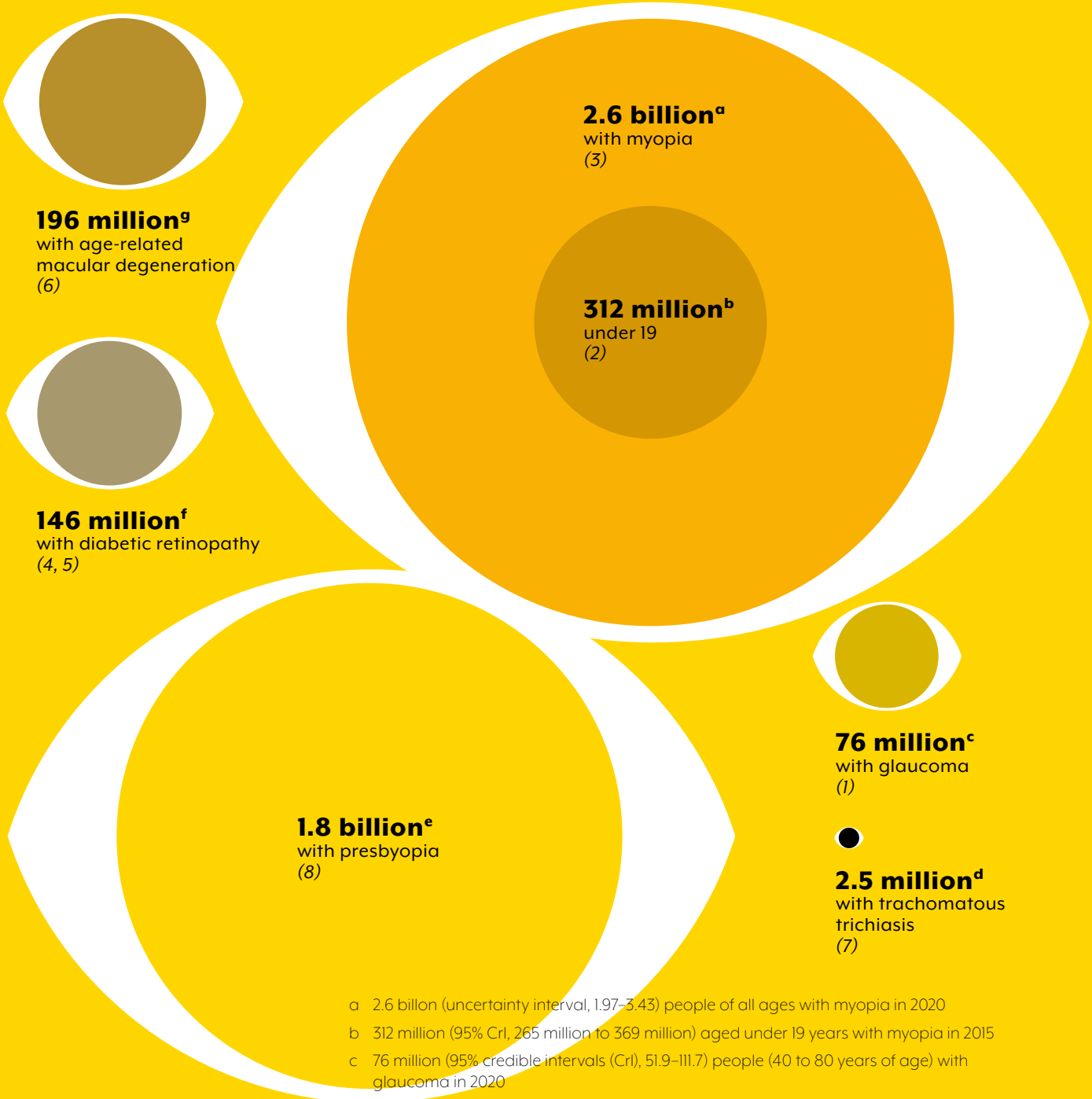
Everyone, if they live long enough, will experience at least one eye condition in their lifetime. For example, many people will have had conjunctivitis as a child, will need spectacles due to presbyopia at some point after 40 years of age, or require cataract surgery later in life.

**Eye conditions are remarkably common.**

Estimates of the number of people globally with eye conditions that can cause vision impairment demonstrate just how common such conditions are (Fig. 2.1) *(1–7)*. However, since a person can have more than one eye condition, these figures cannot simply be summed to derive a global estimate of the total number of people affected by eye conditions that can cause vision impairment. Global estimates of the number of people with, and prevalence of, at least one eye condition are not available.

Although reliable global estimates are lacking for the prevalence of eye conditions that do not typically cause vision impairment but are common reasons for care-seeking behaviour, some data are available. A review of 20 population-based studies from around the world estimated the global prevalence of pterygium to be 10.2% *(9)*, with rates ranging from 2.8% in an urban area of Australia, to as high as 33% in rural China *(10, 11)*. Subnational epidemiological data on the prevalence of dry eye syndrome among adults aged 40 years and older have also been documented in many countries, with rates as low as 8% reported in the United States of America *(12)* to higher than 30% in some regions of Taiwan and China *(13, 14)*.

Figure 2.1 Global estimates of numbers of people affected by selected eye conditions that can cause vision impairment




a 2.6 billon (uncertainty interval, 1.97–3.43) people of all ages with myopia in 2020

b 312 million (95% CrI, 265 million to 369 million) aged under 19 years with myopia in 2015

c 76 million (95% credible intervals (CrI), 51.9–111.7) people (40 to 80 years of age) with glaucoma in 2020

d 2.5 million people of all ages with trachomatous trichiasis in 2019

e 1.8 billion (confidence interval [CI], 1.7–2.0) people of all ages with presbyopia in 2015

f 146 million adults with diabetic retinopathy was calculated by applying the global prevalence of any diabetic retinopathy (34.6%) reported by Yau et al. [2012] to the estimated global number of adults aged over 18 years of age with diabetes in 2014 (422 million) that was reported in the WHO Global Report on Diabetes, 2016.

g 195.6 million (95% CrI 140–261) people aged 30 to 97 years with age-related macular degeneration in 2020

# Global magnitude: vision impairment

**Globally, at least 2.2 billion people have a vision impairment.**

Globally, at least 2.2 billion people have a vision impairment. In at least 1 billion – or almost half – of these cases, vision impairment could have been prevented or has yet to be addressed.

Accurate estimates of the total number of people globally with vision impairment cannot be calculated based on current available data. This is because population-based surveys do not typically report vision impairment in those who wear spectacles or contact lenses to compensate for the vision impairment from a refractive error. Nonetheless, it can be assumed with confidence that at least 2.2 billion people globally have a vision impairment or blindness (Box 2.1). This figure takes into consideration those with near vision impairment due to presbyopia (1.8 billion, including both addressed and unaddressed presbyopia), and moderate to severe distance vision impairment or blindness due to unaddressed refractive error (123.7 million, e.g. myopia or hypermetropia)[1], cataract (65.2 million), age-related macular degeneration (10.4 million), glaucoma (6.9 million), corneal opacities (4.2 million), diabetic retinopathy (3 million), trachoma (2 million), and other causes (37.1 million), including those causes that were not classified in surveys or do not fit into any of the aforementioned categories. In addition, this figure also takes into consideration 188.5 million people with mild vision impairment in which the causes are unknown.

**Box 2.1. Data sources used to calculate the global number of people with vision impairment**

The estimate of at least 2.2 billion people globally having a vision impairment is based on recently published epidemiological data on i) the global magnitude of near vision impairment (Fricke et al. [2018] *(8))* and; ii) the global magnitude and causes of bilateral distance vision impairment and blindness (the Vision Loss Expert Group;* Bourne et al. [2017]) *(15, 16)*).

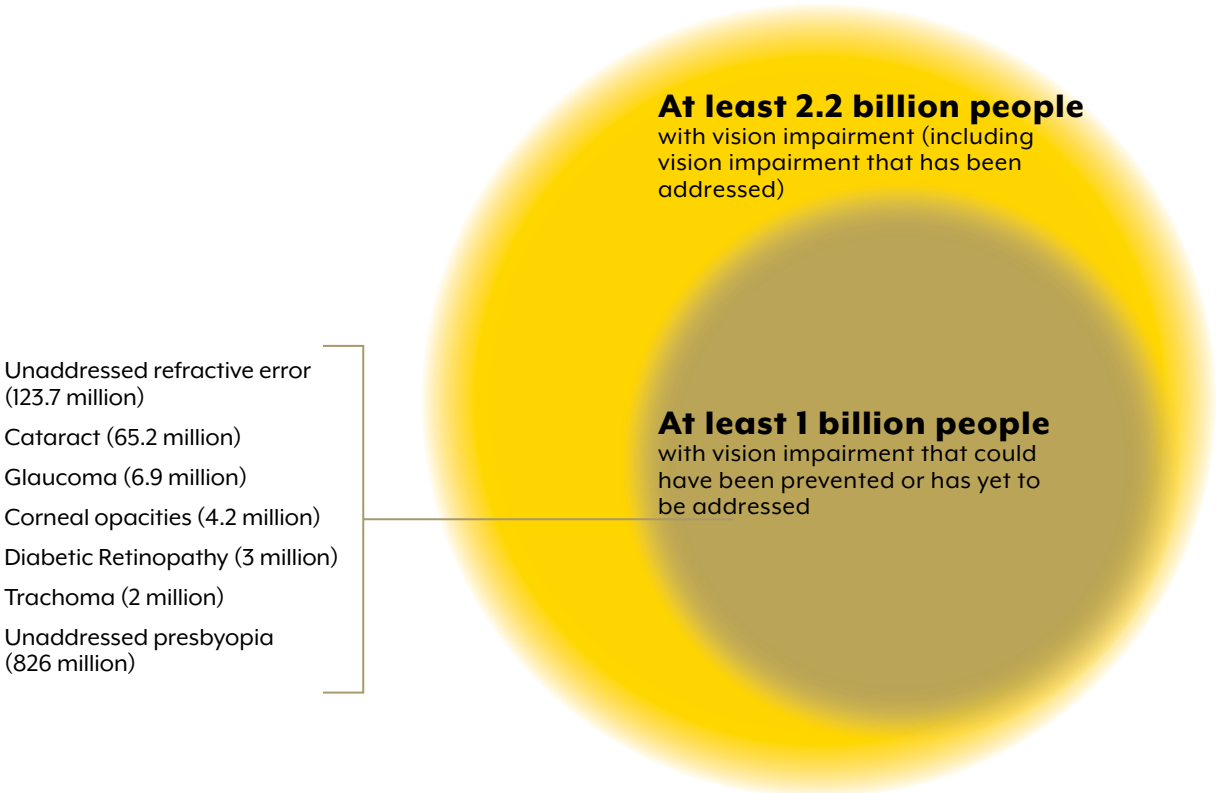
* The Vision Loss Expert Group is an expert group of mainly ophthalmologists and optometrists in ophthalmic epidemiology

Of the 2.2 billion people with vision impairment globally, available data suggest a conservative estimate of at least 1 billion people with vision impairment or blindness that could have been prevented or has yet to

1 Given individuals can have both presbyopia and distance vision impairment due to unaddressed refractive error, it is possible that there is some overlap between the 123.7 million people with vision impairment or blindness due to unaddressed refractive error and the 1.8 people with near vision impairment caused by presbyopia.

be addressed[2] (Fig. 2.2). This number includes those with moderate or severe distance vision impairment or blindness due to unaddressed refractive error (123.7 million), cataract (65.2 million), glaucoma (6.9 million), corneal opacities (4.2 million), diabetic retinopathy (3 million), and trachoma (2 million) *(16)*, as well as near vision impairment caused by unaddressed presbyopia (826 million) *(8)*.

Figure 2.2 Estimated global number of people with vision impairment and those with vision impairment that could have been prevented or has yet to be addressed




The estimate of 1 billion, however, certainly represents an underestimation as data on the prevalence and causes of vision impairment in child populations is limited and likely to reflect an underestimation of the actual number of children with vision impairment. Additionally, the proportion of vision impairment and blindness cases due to age-related macular degeneration (estimated at 10.4 million) that could have been prevented is unknown *(16)*. Lastly, data on the causes of vision impairment for 188.5 million people globally living with mild distance vision impairment *(15)*, and millions of others with moderate to severe distance vision impairment or blindness *(16)*, are not available and therefore it is not possible to determine whether their vision impairment could have been prevented or has yet to be addressed.

2 Defined as vision impairment or blindness that could have been prevented or has yet to be addressed by known, cost-effective means.

# The costs of addressing the coverage gap[3]

**The cost gap for vision impairment or blindness that could have been prevented or has yet to be addressed is an additional $24.8 billion US dollars.**

The costs of the coverage gap for unaddressed refractive errors[4] and cataract[5] globally are estimated to be $24.8 billion US dollars. These are the additional costs that would be required to the current health system using an immediate time horizon.

This financial investment is needed immediately; it requires appropriate planning and relies on additional investment to strengthen existing health systems. For example, WHO has estimated that in order to achieve the global health targets set for 2030, low- and middle-income countries will need to invest in an additional 23 million health workers, and build more than 415000 new health facilities[6]. The estimated US$24.8 billion represent an additional investment to these health workforce and infrastructure needs.

Today, millions of people live with vision impairment or blindness that could have been prevented but, unfortunately, was not. While the exact number is unknown, it is estimated that 11.9 million people globally have moderate or severe vision impairment or blindness due to glaucoma, diabetic retinopathy and trachoma that could have been prevented. The estimated costs of preventing the vision impairment in these 11.9 million would have been US$32.1 billion.[7] This represents a significant opportunity missed in preventing the substantial personal and societal burden associated with vision impairment and blindness.

3 Background information on the estimated costs can be found in: https://www.who.int/publications-detail/world-report-on-vision

4 This includes 123.7 million people with moderate or severe distance vision impairment or blindness and 826 million people near vision impairment

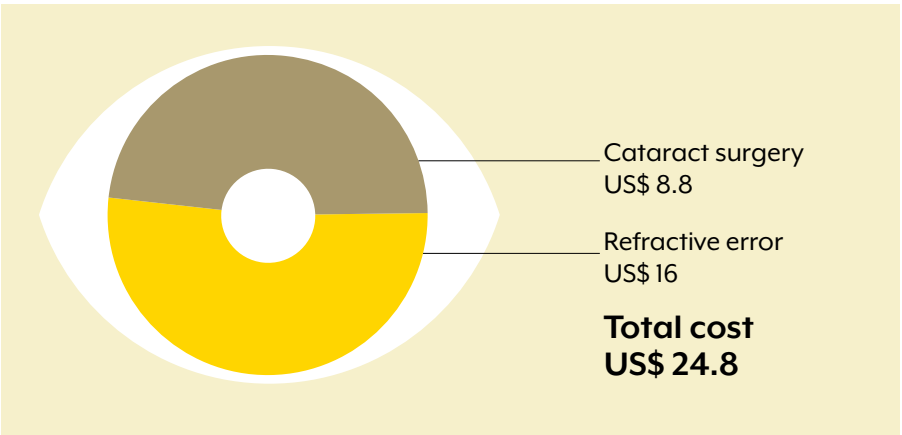
5 This includes 65.2 million people with moderate or severe distance vision impairment or blindness due to cataract.

6 Stenberg K, Hanssen O, Edejer TT, Bertram M, Brindley C, Meshreky A, et al. Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries. The Lancet Global Health. 2017;5(9):e875–e87.

7 The costs that would have been required to prevent vision impairment due to corneal opacities are not included in these estimates. While it is acknowledged that cost-effective interventions are available to prevent the majority of cases of vision impairment and blindness due to corneal opacities (e.g. those caused by injury, vitamin A deficiency, measles infection), the available data do not provide an accurate breakdown of the causes.

It is important to note that the cost estimates presented in this section do not provide the basis for country planning; rather they represent global estimates of addressing the current backlog of moderate or severe vision impairment or blindness due to preventable or addressable causes only. The costs of care required for those who will incur eye conditions and vision impairment in the future are not included. In addition, the ongoing care required for those whose eye care needs are already being met are not taken into account.

Breakdown of costs (US$ billions)



# Distribution[8]

The distribution of the burden of most eye conditions and vision impairment is not equitable. The main dimensions on which distribution varies are region and income level, age and gender, and area of residence.

## Eye conditions

*By region and income level*

Many eye conditions are unevenly distributed globally. Children in Africa and Asia are at greatest risk of acquiring measles, rubella and vitamin A deficiency disorder and their associated eye-related complications *(17-19)*. Trachoma, the main cause of infectious vision impairment, is still to be eliminated in some parts of 44 countries of Africa, Central and South America, Asia, Australia and the Middle East *(7)*.

**The overall prevalence of myopia is highest in high-income countries of the Asia-Pacific region (53.4%), closely followed by East Asia (51.6%)**

The overall prevalence of myopia is highest in high-income countries of the Asia-Pacific region (53.4%), closely followed by East Asia (51.6%) *(3)*, while in country estimates among adolescents in urban areas of China and South Korea have reported rates as high as 67% and 97%, respectively *(20)*.

With respect to common age-related eye conditions, glaucoma is most prevalent in Africa (4.8%) and Latin America and the Caribbean (4.5%) *(1)*. Of note, persons of African descent and Latin American heritage residing in high-income countries, such as the United States of America, also have high rates of glaucoma *(21, 22)*. Regional heterogeneity also exists for age-related macular degeneration, with the highest reported prevalence in Caucasian populations in Europe (57.4% of people aged 45–85 years for any age-related macular degeneration) *(6)*.

Regional comparisons of the total number of people with selected eye conditions are provided in Annex 1.

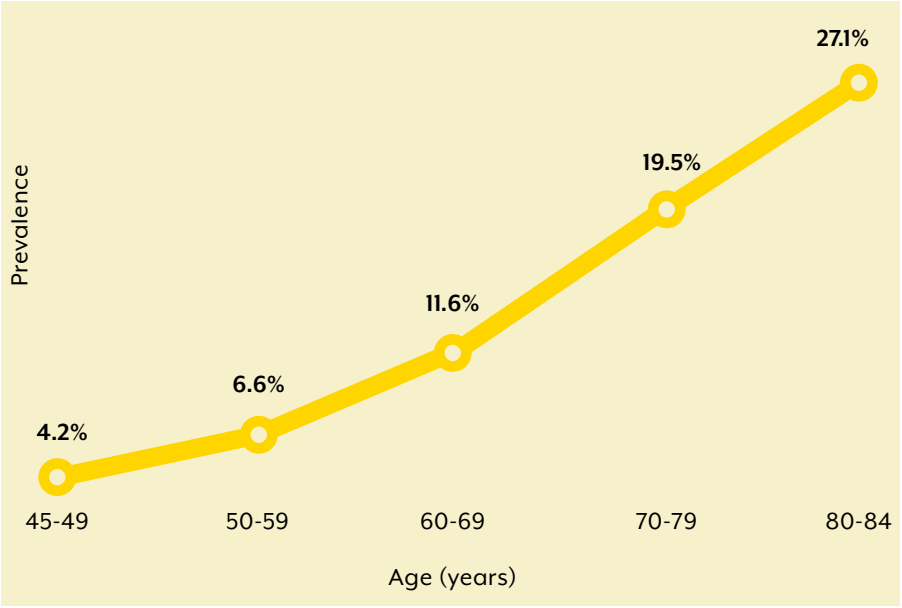
*By age and gender*

Distribution of eye conditions varies across ages due to the typical age of onset. While some eye conditions, such as myopia *(20)*, retinopathy of

8 WHO regions cannot be used in all instances as evidence for the section of the report on the distribution of eye conditions and vision impairment was derived from publications that adopted different regional classifications. Thus data relating age-related macular degeneration and glaucoma used the regional classifications of Europe, Asia, Africa, Northern America, Latin America and the Caribbean, and Oceania, whereas data on myopia and near and distance vision impairment were categorized according to Global Burden of Disease regions: i) Central Europe, Eastern Europe and Central Asia; ii) High Income; iii) Latin America and Caribbean; iv) North Africa and Middle East; v) sub-Saharan Africa; vi). South-East Asia, East Asia and Oceania. A list of countries included within each of these regions is provided in Annex 2.

prematurity *(23)* and amblyopia *(24)* occur in childhood, the risk of others, including cataract, presbyopia, glaucoma and age-related macular degeneration, increase with age. Presbyopia rarely develops before 40 years of age *(8)*. The overall prevalence of age-related macular degeneration is estimated to increase 7-fold, from 4.2% in those aged 45–49 years, to 27.2% in those aged 80–85 years (Fig. 2.3) *(6)*; similar age-related trends have been observed for glaucoma *(1)*. The prevalence of cataract also increases sharply with age. A recent review of population-based surveys in China estimated the national prevalence of age-related cataract to be 73% in those aged 85–89 years, approximately 11 times higher than in those aged 45–49 years *(25)*.

Figure 2.3 Age-group specific prevalence estimates for (any) age-related macular degeneration




*Adapted from:* Wong WL, Su X, Li X, Cheung CM, Klein R, Cheng CY, et al. Global prevalence of age-related macular degeneration and disease burden projection for 2020 and 2040: a systematic review and meta-analysis. The Lancet Global health. 2014;2(2):e106–16.

At a global level, no strong association exists between gender and many eye conditions, including glaucoma, age-related macular degeneration, and diabetic retinopathy *(1, 5, 6)*. However, rates of cataract and trachomatous trichiasis are higher among women, particularly in low- and middle-income countries *(26-28)*. Women may be more susceptible to trachoma than men due to greater contact with children in their role of the primary caretaker of the household *(26)*. While greater life expectancy may contribute to the higher prevalence of cataract among women in these settings, other factors have also been implicated (details provided below).

**The prevalence of vision impairment in low- and middle-income regions is estimated to be four times higher than in high-income regions.**

*By area of residence*

Area of residence is an important determinant of many eye conditions. For example, trachoma is largely found in poor, rural communities that have inadequate access to water, sanitation and health care *(29)*. Rural populations also face greater barriers to accessing eye care due to distances to travel and poor road quality, among other factors *(30, 31)*. Therefore, it is not surprising that a lower cataract surgical coverage and associated higher prevalence of cataract has been reported in rural areas of many countries *(27, 28, 32, 33)*. Area of residence may likewise be an important determinant of childhood myopia. Unlike cataract, higher rates of childhood myopia have been found in urban populations of China and Australia *(34-38)*. These may be due to the impact of lifestyle differences (e.g. children living in rural areas spend more time outdoors), urbanization and/or differences in school systems and demographic characteristics such as socioeconomic status and ethnicity *(36)*.

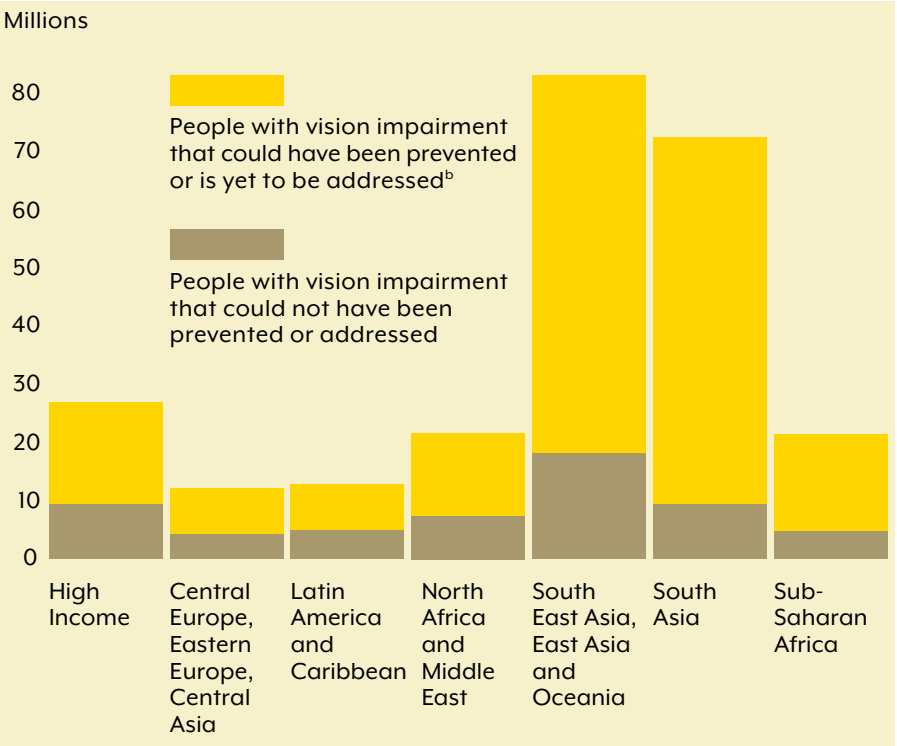
## Vision impairment

All estimates of distance vision impairment and blindness discussed in this section use the definition of "presenting visual acuity" and therefore do not include those who wear spectacles or contact lenses that compensate for their vision impairment. This group do not, therefore, reflect the distribution of the total number of people with distance vision impairment. As described in Chapter 1, the term "presenting distance vision impairment" is used in this report when describing these cases.

*By region and income level*

Considerable variation is observed in the distribution of *presenting distance vision impairment* between regions (Fig. 2.4) and country income level. The prevalence in many low- and middle-income regions is estimated to be four times higher than in high-income regions *(15)*. Three Asian regions alone (representing 51% of the world's population) account for 62% of the estimated 216.6 million people in the world with moderate and severe bilateral *presenting distance vision impairment*: South Asia (61.2 million); East Asia (52.9 million); and South-East Asia (20.8 million) *(15)*. In line with these estimates, the prevalence of bilateral blindness in low- and middle-income regions of western and eastern sub-Saharan Africa (5.1%) and South Asia (4.0%) are reported to be eight times higher than in all high-income countries (<0.5%) *(15, 39)*.

Figure 2.4 Regional comparison[a] of total number of people with bilateral moderate to severe distance vision impairment or blindness and estimated proportion with vision impairment that could have been prevented or has yet to be addressed




a By Global Burden of Disease regions

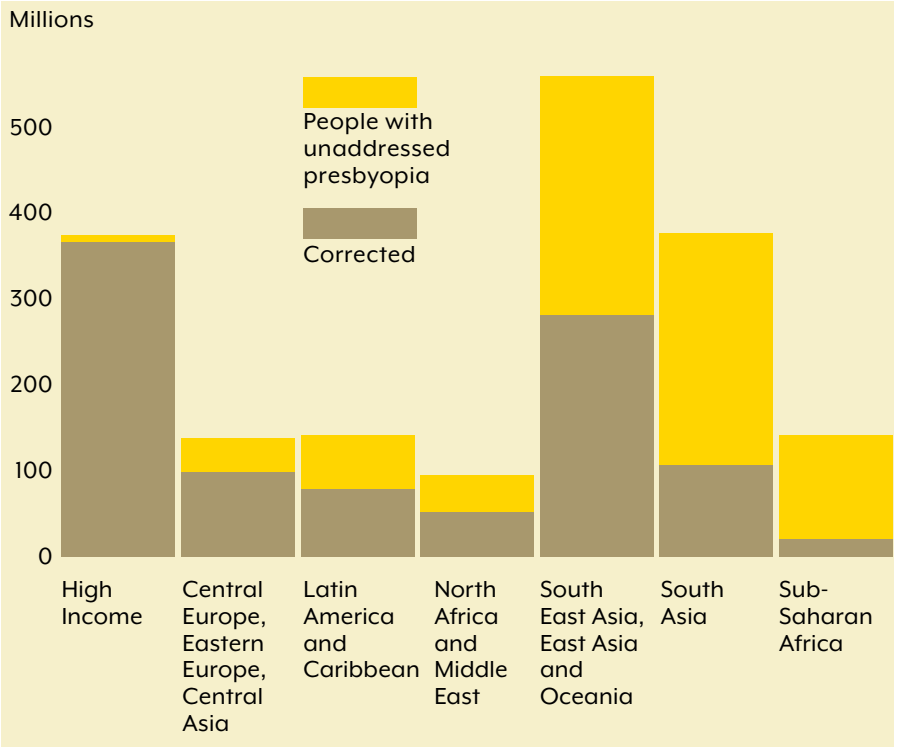
b Based on the number of people with moderate to severe distance vision impairment or blindness caused diabetic retinopathy, trachoma, corneal opacity, glaucoma, unaddressed refractive error and cataract.

*Adapted from:* Flaxman SR, Bourne RRA, Resnikoff S, Ackland P, Braithwaite T, Cicinelli MV, et al. Global causes of blindness and distance vision impairment 1990–2020: a systematic review and meta-analysis. The Lancet Global Health. 2017;5(12):e1221–e34

**The prevalence of any near vision impairment is highest in regions with longer life expectancies.**

The prevalence of any near vision impairment is highest in regions with longer life expectancies (Fig. 2.5), while the greatest burden of near vision impairment yet to be addressed, occurs in low- or middle-income countries *(8)*. For example, rates of unaddressed near vision impairment are estimated to be greater than 80% in western, eastern and central sub-Saharan Africa, while comparative rates in high-income regions of North America, Australasia, Western Europe, and of Asia-Pacific are reported to be lower than 10% *(8)*.

Figure 2.5 Regional comparison of presbyopia showing total number of people with presbyopia and proportion of cases with near vision impairment resulting from unaddressed presbyopia




*Adapted from:* Fricke T TN, Resnikoff S, Papas E, Burnett A, Ho S, Naduvilath T, Naidoo K. Global prevalence of presbyopia and vision impairment from uncorrected presbyopia: systematic review, meta-analysis and modelling. Ophthalmology. 2018.

### *Indigenous populations and ethnic minorities*

Most countries with indigenous peoples and ethnic minorities have no data on the burden of vision impairment for these groups. However, those that do consistently report higher rates of *presenting distance vision impairment* among these population subgroups *(40-43)*. For example, recent epidemiological surveys conducted in Australia (2015), and Chiapas State, Mexico (2015) *(44, 45)*, reported rates of *presenting distance vision impairment* in indigenous adult populations approximately two times higher than in the general population. In line with these findings, a survey in Nakuru, Kenya reported the odds of being blind were 2.5 times higher in indigenous Kalenjin people than in the non-indigenous population *(46)*.

There is some evidence from high-income countries that ethnic minorities are more commonly afflicted by vision impairment. For example, African–American and Hispanic individuals residing in the United States of America experience a higher prevalence of *presenting distance vision impairment* and blindness when compared with non-Hispanic Caucasian individuals *(47)*. While, in the United Kingdom, those of African descent and South Asian heritage with diabetes are reported to have a higher prevalence of vision impairment *(42)*.

*By age and gender*

Given that age is the principal risk factor for many eye conditions, the prevalence of *presenting distance vision impairment* is much greater in older age groups. It has been estimated that 80% of bilateral *presenting distance vision impairment* and blindness, and two thirds of near vision impairment occur in persons aged 50 years or older *(47, 48)*. While the prevalence of *presenting distance vision impairment* in this age group has been studied extensively, comparatively little population-based data are available for vision impairment for all ages.

Women, on average, live longer than men, and are thus at greater risk of developing eye conditions associated with ageing. For example, in a national survey in Nigeria, the prevalence of mild and moderate *presenting distance vision impairment* in women was approximately 30% higher than in men *(49)*. However, even after controlling for age, global estimates suggest that women with moderate and severe *presenting distance vision impairment* outnumber men by approximately 7% *(15)*.

*By area of residence*

There is a paucity of recent survey data from countries making direct (i.e. within survey) comparisons of the prevalence of vision impairment and blindness between urban and rural populations. However, previous studies that have, including those conducted in China *(50)* and Ghana *(51)*, indicate that people in rural areas are at higher risk of distance vision impairment and blindness than their urban counterparts. In addition, indirect (i.e. between survey) comparisons between urban and rural populations in the same country supports the view that vision impairment tends to be more prevalent amongst rural populations. For example, in India, the age-specific prevalence of *presenting distance vision impairment* in an urban population of Delhi (19.7% in 60-69 year olds) was approximately one-third lower than that of a rural population in northern India (28% in 60-69 year olds) *(52, 53)*.

# Access and barriers to eye care services

The use of eye care services is uneven, and is determined by the availability, accessibility, affordability, and acceptability of such services.

The prevalence of eye conditions and vision impairment is influenced by the use of eye care services that prevent vision impairment or maintain or restore vision. The significant variations in the use of eye care services existing between populations contribute to those in the distribution of eye conditions and vision impairment.

**Eye conditions and vision impairment are influenced by the use of eye care services.**

Several national and subnational surveys have reported the use of eye care services being generally greater in high-income than in low- and middle-income countries *(54-60)*. Cataract surgery coverage rates – an indicator of eye care service provision within populations – also show marked variations by income level: subnational population surveys conducted in Viet Nam, Yemen and Malawi reported rates lower than 40%, while rates higher than 80% were reported in countries such as Uruguay, Argentina and Australia *(61, 62)*. It is important to emphasize that there some are exceptions: a sub-national survey from Iran, for example, reported cataract surgery coverage rates of over 90% *(62)*.

The use of eye care services is influenced by multiple interdependent factors, including the availability, accessibility, affordability, and acceptability of services. The impact of these factors on the distribution of eye conditions and vision impairment is discussed in this section.

## Availability

A shortage of trained human resources is one of the greatest challenges to increasing the availability of eye care services and reducing the prevalence of vision impairment and blindness that could have been prevented or has yet to be addressed. The distribution of the eye care workforce should be based on population needs. Unfortunately, this is not the case currently *(63-65)*. For example, in many countries, eye care needs are higher in rural settings where there are very few health workers involved in eye care *(63, 65, 66)*.

Globally, ophthalmologists are responsible primarily for performing eye surgery and treating all common eye conditions, such as glaucoma, diabetic retinopathy and age-related macular degeneration. A recent (2019) study of the ophthalmology workforce covering 198 countries (i.e. 94% of the global population) reported that, while the number of practising ophthalmologist is increasing in most countries, there is inequitable distribution, and a significant shortfall in the current and projected number of ophthalmologists *(67)*. This is particularly important

in many low- and middle-income countries. Critical human resource shortages have also been identified for optometrists and other allied ophthalmic personnel, such as opticians, refractionists, orthoptists, ophthalmic assistants, ophthalmic nurses etc *(68, 69)*. Several of these are the key professional groups involved in the management of refractive error worldwide. Due to this serious shortage of ophthalmologists and optometrists, other allied ophthalmic personnel play a major role in the provision of a broad range of eye care services, particularly in low- and middle-income countries, and at primary health care (PHC) level.

Even where health workers are available, essential ophthalmic equipment to manage ocular conditions frequently is not, particularly in the public sector of some low- and middle-income settings *(70)*. For example, the results of an ophthalmic equipment survey of 173 health care settings (56% tertiary hospitals) located predominantly in regions of Africa (70.5%) and South-East Asia (13.3%) revealed that more than 60% of services did not have a photocoagulation laser – a primary intervention for vision-threatening diabetic retinopathy *(70, 71)*. A recent national survey of practice patterns and management of glaucoma in Nigeria reported that only approximately 30% of ophthalmologists had access to laser equipment, while basic diagnostic equipment was not available in 15–20% of clinics *(72)*.

**The integration of eye care services within primary health care is fundamental.**

A considerable shortage of corneal graft tissue and limited access to corneal transplant programmes also exist in many countries[9]. Improved data on donation rates and population needs, coupled with clear policies and legislation and supportive governance oversight on both donation and transplantation, are required for Member States to establish sustainable corneal banking programmes.

The reality that the vast majority of eye care services in low- and middle-income countries are provided in secondary or tertiary hospitals, which are principally located in urban areas, adds to the inequity in access. This highlights the importance of both strengthening the integration of eye care services within primary health care, and ensuring an effective referral pathway to secondary and tertiary care settings for timely treatment of eye conditions.

## Accessibility

Many barriers – related, for example, to gender, socioeconomic status, and perceived cost of eye care – can prevent patients from accessing services. In some settings, women do not have the same access to eye services as men. Reviews of population-based surveys conducted in low- and middle-income countries consistently reported that women are significantly less likely to undergo cataract surgery than men *(28, 62)*. This gender inequity in the use of eye care services could be

9 Gain P, Jullienne R, He Z, Aldossary M, Acquart S, Cognasse F, et al. Global survey of corneal transplantation and eye banking. JAMA Ophthalmol. 2016;134(2):167-73.

explained by a range of socioeconomic and cultural factors, including greater challenges for women in travelling to health services due to limited financial decision-making power and minimal experience in travelling outside their community *(73, 74)*. This gender disparity is not present in all countries, however: recent reports from high-income settings in Australia and Canada found that men used eye care services less frequently than women *(54, 75)*. A growing body of evidence also suggests that people who have disabilities, such as a hearing, physical, or intellectual disability, face greater challenges in accessing eye care services than those who do not *(76-79)*.

Socioeconomic status has also consistently been reported as a key determinant of the use of eye care services *(56, 80, 81)*, with a tendency for eye care use to decrease with increasing socioeconomic disadvantage.

**People who have disabilities face greater challenges in accessing eye care services than those who do not.**

Poor eye health literacy is associated with suboptimal adherence to eye examination guidelines, and poorer eye health outcomes *(82-84)*. Additionally, lack of knowledge of the availability of services has been identified as a barrier to eye care use among high risk populations, including homeless *(85, 86)* and refugee *(87)* populations in high-income countries. Older people tend to use eye care services less frequently, often considering a reduction in vision as part of the normal ageing process, and unaware that many eye conditions can be treated or that rehabilitation may improve their functioning *(88)*.

In the absence of accessible eye care services, people with eye or vision problems, particularly in low-income settings, resort to self-medication using local remedies, or access local informal providers such as drug sellers, or traditional or spiritual healers. These interventions can be harmful and can also delay accessing more appropriate care. For example, in the Nigeria national survey almost half of the participants who had undergone a procedure for cataract had been couched (a traditional procedure) and almost three quarters of these eyes were blind *(89)*.

Perceived high costs have been cited as a barrier to accessing eye care in a number of settings *(90-92)*. In some cases, for example treating cataract or diabetic retinopathy, the costs combined with the lack of sufficient information about the benefits may result low willingness to pay associated to insufficient information about the benefits *(33, 93, 94)*.

### Affordability

Affordability of eye care services is influenced by income level, direct costs (e.g. costs of treatment, or purchasing spectacles, contact lenses or low vision devices), indirect costs, and health insurance status. Many eye conditions, such as refractive error and diabetic retinopathy, affect adults of working age. Therefore, it is not surprising that indirect costs of care, including the loss of productivity and foregone earnings for the

patient and caregiver, are common reasons for non-attendance at eye care appointments *(94, 95)*. In other circumstances, a failure to access care can be more an issue of opportunity costs, where basic living needs (e.g. food production for family) outweigh concerns related to eye health *(96)*.

Direct costs, including costs involved in accessing eye care, transport to appointments and related pharmaceutical interventions, have also been cited extensively as primary barriers to accessing care, particularly in low- and middle-income countries *(33, 94)*. This may be partly explained by the fact that approximately 50% of people in low- and middle-income countries live more than one hour of a city (compared with 10% in high-income countries) *(97)*, making transport to eye care services challenging. Nonetheless, direct costs have also been cited as a key barrier to accessing eye care in high-income countries, particularly for people living in rural areas or those with low socioeconomic status *(98)*.

**Direct costs, including transport to appointments and related pharmaceutical interventions are barriers to accessing care.**

Further evidence of the impact of direct eye care costs is found in studies that have reported consistently that patients without health insurance have notably lower rates of use of eye care services than those with insurance *(58, 99, 100)*. This becomes a greater issue when services in the public sector are limited due to human resource shortages and when most people either do not have the required health insurance coverage for, or cannot afford, treatment in the private-for-profit sector. A recent review of health system dynamics in Trinidad and Tobago revealed that private sector optometrists and ophthalmologists provide 80% of all eye care, while less than 20% of the adult population were reported to have health insurance that covers care provided by the private sector *(101)*. It is therefore unsurprising that a recent population-based survey in Trinidad and Tobago reported that a lack of health insurance was a key risk factor for vision impairment among adults *(102)*.

### Acceptability

The acceptability of eye care is seldom considered but has substantial consequences on the use of services and subsequent eye health outcomes. It is a multifaceted concept that is related to the characteristics of the health workforce (e.g. sex, language, culture, age); the degree to which a person understands an intervention; and whether the person considers the intervention will achieve the expected outcome *(103)*.

Previous literature has reported that the acceptance of wearing spectacles is often influenced by factors such as cosmesis, the belief that spectacles identify the wearer as having a disability, or that vision worsens with continued spectacle wear *(104, 105)*. A distrust of service quality has been cited as a barrier to the uptake of eye care services. For example, a study among children in China reported that a low acceptance of free or low-cost spectacles was related to parental

beliefs that the spectacles were of poor quality *(106)*. A distrust of service quality, along with fear of the procedure, have also been cited consistently as barriers to the uptake of cataract surgery and other services in many countries *(106-108)*.

The role of cultural factors in health service acceptability has also been explored. For example, indigenous peoples are more likely to access eye care if it is culturally appropriate and well-integrated within their community-based health service *(109)*. Similarly, higher levels of patient engagement and satisfaction have been reported when there is concordance in language and/or ethnicity between patients and health care professional *(110)*. In some cultures, gender-sensitivities may also arise when care is provided by a health care worker of the opposite gender.

**Acceptance of wearing spectacles is often influenced by factors such as cosmesis, the belief that spectacles identify the wearer as having a disability, or that vision worsens with continued spectacle wear.**

# Projections of eye conditions

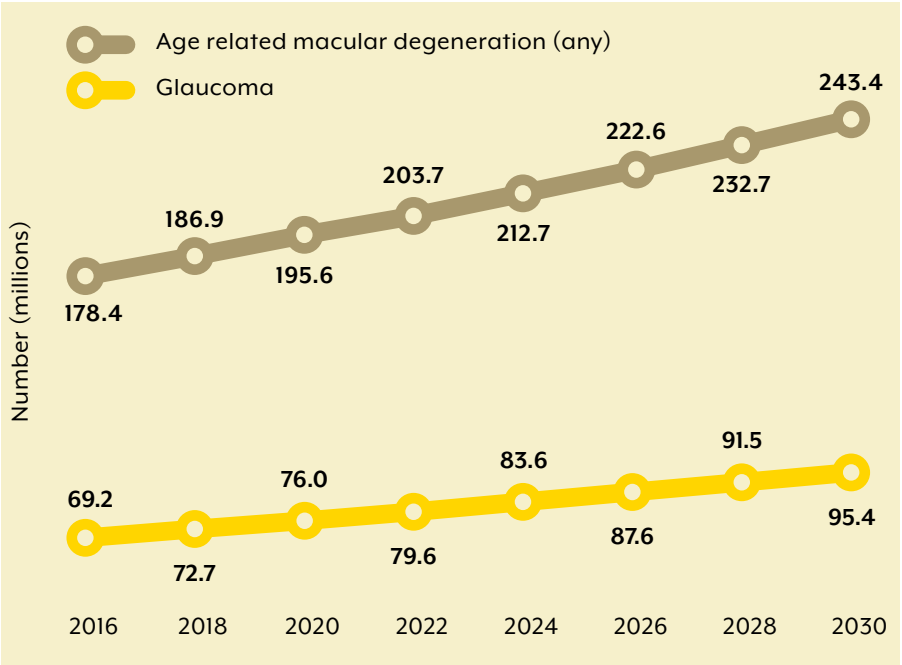
**Population ageing, coupled with environmental and lifestyle changes, will lead to a dramatic increase in the number of people with vision impairment and blindness.**

## Population ageing

Population ageing will impact significantly the number of people with eye conditions. By 2030, the number of people worldwide aged 60 years and over is estimated to increase from 962 million (2017) to 1.4 billion, while numbers of those aged over 80 years will increase from 137 million (2017) to 202 million *(111)*. These population changes will lead to considerable increases in the numbers of people with major eye conditions that cause vision impairment.

The number of people with the age-related eye condition glaucoma, for example, has been projected to increase 1.3 times between 2020 (76 million) and 2030 (95.4 million); and those with age-related macular degeneration, 1.2 times between 2020 (195.6 million) and 2030 (243.3 million) (Fig. 2.6) *(1, 6)*. Similarly, the number with presbyopia is projected to increase from 1.8 billion in 2015, to 2.1 billion in 2030 *(8)*. As most people over the age of 70 will develop cataract, the number with this condition will also increase substantially. Population ageing will also lead to an increase in the number of people with other eye conditions, including those that do not usually cause vision impairment, such as dry eyes.

Figure 2.6 Projected number of people worldwide with glaucoma and age-related macular degeneration (to year 2030)



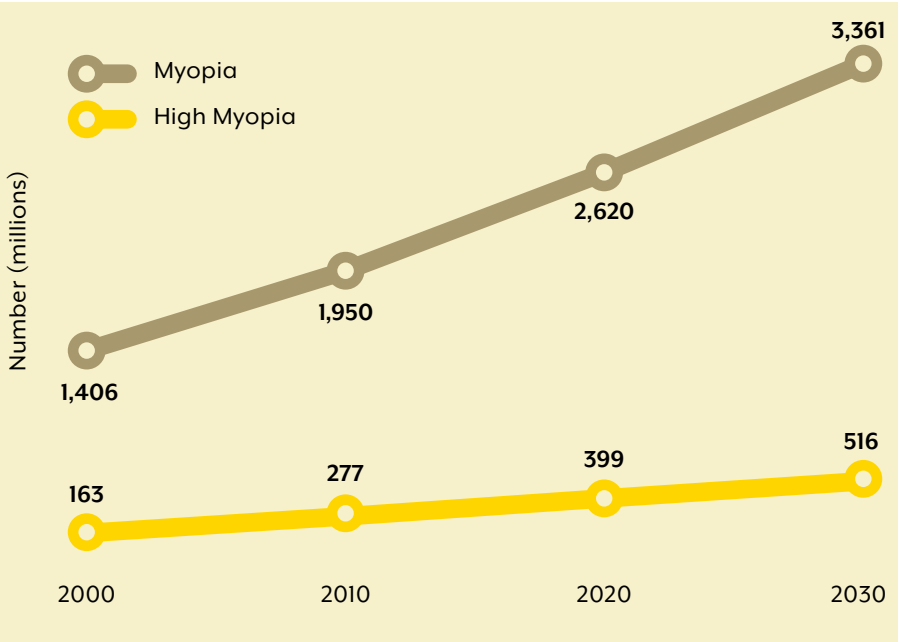

*Adapted from:* Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. Ophthalmology. 2014;121(11):2081–90; and Wong WL, Su X, Li X, Cheung CM, Klein R, Cheng CY, et al. Global prevalence of age-related macular degeneration and disease burden projection for 2020 and 2040: a systematic review and meta-analysis. The Lancet Global Health. 2014;2(2):e106–16.

## Lifestyle

Changes in lifestyle are also likely to result in an increased number of people with eye conditions. For example, reduced time spent outdoors, increased near work and increased rates of urbanization, among other factors, may contribute towards a substantial increase globally in the number of people with myopia. According to estimates that take into account the growth in urbanization and in the human development index, the number of people with myopia will increase from 1.95 billion in 2010 (uncertainty interval (UI) 1422 million to 2543 million) to 3.36 billion in 2030 (UI 153 million to 589 million) *(3)*. During the same period, the number of people with high myopia, often associated with severe complications, is projected to increase from 277.2 million in 2010 (UI 153 million to 589 million) to 516.7 million in 2030 (UI 298 to 1082 million) (Fig. 2.7) *(3)*.

Lifestyle changes have also led to an increase in the number of people with diabetes across all countries during the past thirty years *(112)*. If trends continue, the number of people with diabetic retinopathy is estimated to increase from 146 million in 2014 to 180.6 million in 2030 (1.2-fold) *(113)*.

Figure 2.7 Projected number of people estimated to have myopia and high myopia for each decade, 2000–2030




*Adapted from:* Holden BA, Fricke TR, Wilson DA, Jong M, Naidoo KS, Sankaridurg P, et al. Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050. Ophthalmology. 2016;123(5):1036–42

**Health systems face unprecedented challenges in meeting the current and projected demands of eye care needs.**

## Extent of challenges ahead for health systems

Based on current data (as presented in this chapter), it is evident that health systems face unprecedented challenges in meeting the current and projected demands of eye care needs. In addition to addressing the coverage gap of the known global eye care needs – i.e. of at least 1 billion people with vision impairment that could have been prevented or has yet to be addressed, and tens of millions of others with vision impairment or blindness who could benefit from rehabilitation – health systems are also required to sustain care for those whose needs are currently being met and are receiving appropriate care. The magnitude of met need is currently unknown and, as discussed in Chapter 6, health systems will be required to collect data systematically on the met needs in order to be able to conduct effective planning.

Ageing, population growth, and the fact that the prevalence of vision impairment and many eye conditions increases in older age, will also lead to a substantial increase in the number of people that need eye care globally. Anticipated increases in the burden of myopia and diabetes due to lifestyle changes will further confound this problem. These demographic changes will impact profoundly the already strained health systems and eye care workforces.

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# Chapter 3

## Addressing eye conditions and vision impairment

Effective interventions are available for health promotion, prevention, treatment and rehabilitation to address the entire range of needs associated with eye conditions and vision impairment across the life course. Some are among the most feasible and cost-effective of all health care interventions to implement.

When vision impairment and blindness cannot be treated, everyday functioning can be optimized through rehabilitation interventions.

**There are effective interventions to address the needs associated with eye conditions and vision impairment.**

A range of effective interventions are available to reduce the risk of acquiring an eye condition or vision impairment, and to mitigate the impact.

As presented in Chapter 1, the range of eye conditions is diverse and while some conditions can cause vision impairment or blindness, others typically do not. Although a few eye conditions can be prevented (e.g. trachoma and most causes of corneal opacity in children), this is not possible for most. Each eye condition requires a different response.

Fortunately, there are effective interventions covering promotion, prevention, treatment and rehabilitation which address the needs associated with eye conditions and vision impairment; some are among the most cost-effective and feasible of all health care interventions to implement. This section provides an overview of key interventions; those highly relevant to adults and children are illustrated in Table 3.1.

### Health promotion

Interventions for health promotion have the potential to increase the adoption of healthy behaviours that affect eye conditions and vision impairment, as well as the uptake of eye care services.

Interventions for health promotion aim to empower people to increase control over their health and its promotive factors through health literacy efforts, rather than by targeting specific risk factors or health conditions. To date, interventions for health promotion in the field of eye care have received less attention and investment than those for prevention and treatment *(1, 2)*. Thus, it is unsurprising that eye- and vision-related outcomes are not included in the evaluation of health promotion programmes. Although public health education campaigns linking smoking and blindness have proved effective in increasing awareness and encouraging smokers to seek cessation supports *(3-5)*, there is no evidence to suggest that such interventions impact the prevalence of vision impairment.

Only a few key evaluated examples of interventions for health promotion have been found successful in increasing the adoption of health promoting behaviours and the uptake of eye care services *(6)*. Health promotion campaigns targeting improved awareness of the importance of regular eye examinations and the use of eye care services have been shown to be effective among older populations and those with diabetes *(7, 8)*. The use of health promotion activities (e.g.


EJERCICIOS OCULARES
Paso 1:
Mirar hacia arriba
Paso 2:
Mirar hacia abajo
Paso 3:
Mirar hacia la derecha
Paso 4:
Mirar hacia la izquierda
RECUERDA:
Debemos mantener una adecuada iluminación para evitar esforzar nuestra vista.

posters, brochures and health talks) prior to the implementation of outreach eye screening services, conveying messages such as "get your eyes checked" have similarly been successful in increasing uptake of services *(1)*.

The promotion of eye protective behaviours can also be considered interventions for health promotion and may include compliance with spectacle wear, time spent outdoors, and the use of sunglasses among school-aged students *(9-11)*. While these interventions are shown to be effective in some settings, a recent Cochrane review suggests that further research is required *(12)*.

### Prevention

**There are two categories of preventive interventions in the field of eye care.**

Eye conditions that can be targeted effectively with preventive interventions include trachoma, onchocerciasis and myopia. In addition, the prevention or management of other health conditions can be effective in reducing incidence of secondary ocular conditions.

Preventive interventions in the field of eye care generally fit into two categories: (i) interventions that aim to prevent the incidence of eye conditions before they occur by targeting the causes and risk factors; and (ii) measures taken to prevent eye conditions that are secondary to other health conditions. Those addressing trachoma, onchocerciasis and myopia, for example, fit into the former category. Given that onchocerciasis is transmitted by blackflies, earlier control programmes consisted of vector control within communities in endemic regions, followed by establishing sustainable community-directed mass drug administration with ivermectin *(13)*. With trachoma, an effective package of interventions (the "SAFE" strategy) is available, which prevents the transmission of infection (through mass drug administration and environmental sanitation interventions, such as latrines, clean running water, and face cleaning) and visual impairment (by eyelid surgery) (Box 3.1) *(14)*. Preventative lifestyle changes among children, including a combination of increased time spent outdoors and decreased near-work activities, can slow the progression of myopia which reduces the risk of high myopia and its complications *(9, 15)*.

Interventions to prevent health conditions such as vitamin A deficiency, measles and rubella, through vitamin A supplementation and immunization, are highly effective in reducing the risk of corneal opacities that can occur secondary to these conditions *(16, 17)*. With diabetes, the optimal management of key risk factors, such as hyperglycaemia and hypertension, can also prevent or delay onset, and reduce the progression, of diabetic retinopathy *(18, 19)*.

Changes in legislation, such as compulsory seat belt use and restrictions on the use of fireworks, have resulted in a reduction in ocular injuries, and are well documented *(20, 21)*. Targeted campaigns to

improve awareness of trauma prevention strategies, such as the use of protective eye wear in high-risk activities and industries (e.g. certain sports or agricultural activities) may also be effective in reducing eye injuries. Despite this, a recent Cochrane review suggests that the overall impact of preventive educational interventions on the risk of ocular injuries is short-lived and further research is required in this area *(22)*.

**Box 3.1 The elimination of trachoma in previously endemic countries through the implementation of preventative interventions**

*Brief history*

Landmark trials in the 1990s demonstrated the effectiveness of the antibiotic azithromycin *(23, 24)* for reducing the prevalence of active trachoma, and established the place of facial cleanliness campaigns for trachoma control *(25)*. In 1993, WHO endorsed the "SAFE strategy" for trachoma elimination *(26)*. SAFE incorporates multiple strategies to address specific stages of the path to blindness in trachoma, including: Surgery for trichiasis to minimize vision impairment; Antibiotics to clear ocular *Chlamydia trachomatis* infection, and Facial cleanliness and Environmental improvement (particularly improved access to water and sanitation) to reduce *Chlamydia trachomatis* transmission *(26)*.

The WHO Alliance for the Global Elimination of Trachoma by 2020 (GET2020) was established in 1996 and, soon after, the 1998 WHA, in resolution WHA51.11, called on endemic countries to take all actions necessary to achieve the GET2020 goal *(27)*. As a result, antibiotics, facial cleanliness and environmental improvement have been delivered to entire districts in which prevalence of the active trachoma sign "trachomatous inflammation—follicular" is greater than or equal to 5%.

*Progress*

Evidence of substantial progress against trachoma is now available. The SAFE strategy is being implemented, partially or at scale, in at least 32 countries *(28)*. The estimated number of people worldwide living in districts where the A, F and E components of SAFE need to be implemented for trachoma elimination purposes has decreased from 1517 million in 2002 to 142 million in 2019, while the number of people with trichiasis has fallen from 7.6 million to 2.5 million in the same period *(14)*. Eight countries – Cambodia, Ghana, the Islamic Republic of Iran, Lao People's Democratic Republic, Mexico, Morocco, Nepal and Oman – have now been validated by WHO as having eliminated trachoma as a public health problem; a further five – China, Gambia, Iraq, Myanmar, and Togo – have reported achieving elimination prevalence targets *(14)*.

## Treatment

The treatment of eye conditions targets curing as well as addressing symptoms and progression. Treatment also aims to prevent or slow progression towards vision impairment.

Cataract and refractive error are the two leading causes of vision impairment; treatment can address vision impairment and restore vision. Treatment for cataract is a surgical intervention involving the removal of the opaque lens in the eye and the implantation of an artificial intraocular lens. Cataract surgery is highly cost-effective *(29)* and results in significant improvements to QoL *(30)*. While spectacles are undoubtedly the most common intervention used worldwide to compensate for refractive error (Box 3.3), contact lenses and laser refractive surgery are an effective alternative and becoming increasing popular, particularly in high-income settings *(31)*.

**Treatment of eye conditions targets curing as well as addressing symptoms and progression.**

Treatment for other noncommunicable eye conditions are often more challenging, with longer-term follow-up essential to slow the progression of the condition. For example, the prevention of vision impairment from diabetic retinopathy, glaucoma and retinopathy of prematurity, requires early detection, often before the patient is symptomatic. For diabetic retinopathy and retinopathy of prematurity, this involves routine screening to detect the "vision-threatening" stages of the condition, followed by laser therapy or other treatments to reduce the risk of vision impairment or blindness *(32, 33)* (Box 3.2). In the case of glaucoma, ongoing management is required to reduce the risk of further progression through a number of possible interventions including a therapeutic eye drop regimen, laser therapy, surgery, or a combination of these *(34)*. Effective therapeutic interventions, in the form of continuous or intermittent anti-vascular endothelial growth factor (anti-VEGF) intraocular injections, are currently available for the neovascular form of age-related macular degeneration (AMD) (only) *(35, 36)*.

Treatment is available for many eye conditions that do not typically cause vision impairment, such as dry eye, conjunctivitis and blepharitis. Treatment of these conditions is often directed at alleviating the symptoms. In advanced cases of pterygium when vision is affected, surgical intervention is often required *(37)*. Research has demonstrated that the treatment of eye conditions that do not typically cause vision impairment can pose a substantial economic burden on the patient and on society *(38)*.

### Box 3.2 Long-term impact of retinal screening on diabetes-related visual impairment in the working age population: the English National Screening Programme *(39)*

A national systematic diabetic retinopathy screening programme was established in England in 2003 where all individuals with diabetes aged 12 years and over are invited for an annual diabetic eye screening appointment. In line with current recommendations for high resource settings, patients are sent reminders to attend screening. Since 2008, the programme has achieved near comprehensive population coverage (i.e. >80% annual coverage).

In the programme, screening is performed by well-trained screeners who measure visual acuity, instil drops for pupil dilation, carry out two-field retinal photography. Images are then digitally transferred to a centralized location (e.g. established grading centre) for retinal grading by specially trained non-physician technicians. Prior to their involvement in the programme, a minimum qualification is required for screeners and graders *(40)*. In addition, all graders undertake monthly test sets of images and their results are compared to a guide grade. Audit and internal and external quality assurance schemes are also embedded in the service.

Robust sensitivities and specificities for the detection of diabetic retinopathy and sight-threatening diabetic retinopathy (moderate disease or worse) have been reported in this programme *(41)*. Individuals with sight-threatening diabetic retinopathy are referred for timely ophthalmology assessment and management. In addition, all those with poor-quality images are referred for assessment of retinal status via slit lamp examination.

In 2015-16, the diabetic retinopathy screening programme in England screened 2 144 007 people with diabetes (83% coverage) *(39)*. After 7 years of screening for treatable diabetic retinopathy, a review of the blindness registry in England revealed that the condition was no longer the most common cause of blindness in the working age population *(42)*. This provides compelling evidence that systematic diabetic retinopathy screening, coupled with timely treatment of sight-threatening disease, can reduce vision impairment and blindness.

### Box 3.3 Spectacles

WHO considers spectacles or contact lenses *functioning interventions*, as they do not eliminate or cure refractive error by treating its causes *(43)*; rather they are used to compensate for common refractive errors such as myopia, hypermetropia and presbyopia. In the same way, the incorporation of prisms into spectacles can be used to compensate for double vision that occurs due to a range of causes.

Spectacles are also used in the context of vision rehabilitation. This comes, for example, in the form of convex lenses that are incorporated into spectacles to magnify the image to help individuals with low vision to perform their near-tasks comfortably.

Spectacles are also an assistive device and are part of the WHO Priority Assistive Products List.[1] WHO defines assistive devices and technologies as those whose primary purpose is to maintain or improve the functioning and independence of an individual to facilitate participation and to enhance overall well-being *(44)*.

1 See: https://www.who.int/phi/implementation/assistive_technology/global_survey-apl/en/.

## Rehabilitation

Vision impairment and blindness caused by many major eye conditions (e.g. glaucoma and age-related macular degeneration) cannot be treated, and rehabilitation will be required.

Rehabilitation aims to optimize the everyday functioning of those with vision impairment or blindness that cannot be treated in their environment, by maximizing the use of residual vision and providing practical adaptations to address the social, psychological, emotional, and economic consequences of vision impairment *(45)*.

**Vision impairment and blindness caused by many major eye conditions cannot be treated, and rehabilitation will be required.**

The main eye conditions causing vision impairment in adults, and addressed by vision rehabilitation, are glaucoma, AMD, corneal opacities and diabetic retinopathy. The main conditions in children and young adults include congenital, genetic, and acquired eye conditions.

A broad range of vision rehabilitation interventions are available, including optical magnifiers, environmental modification (e.g. improved lighting), reading using Braille, screen readers, smartphone wayfinders, counselling and home skills training, such as orientation and mobility training with white canes to ensure safe ambulation *(46, 47)*. Many eye conditions can impact different components of vision function (e.g. visual acuity, contrast, peripheral vision), thus vision rehabilitation interventions need to be tailored to individual needs and priorities.

Vision rehabilitation interventions greatly assist people with a visual impairment and blindness *(48, 49)*. Additional research is required, however, to determine not only the most efficient and cost-effective interventions but also optimal outcome measures for rehabilitation *(50, 51)*. WHO is currently developing a package of evidence-based rehabilitation interventions to include vision rehabilitation *(52)*. A case example of an integrated low vision rehabilitation service is provided in Box 3.4.

### Box 3.4 An integrated low-vision rehabilitation service: a case example from Sri Lanka *(53)*

Prior to 2008, vision rehabilitation services for the whole of Sri Lanka were provided by three low-vision clinics only, located within tertiary hospital settings. However, when Sri Lanka's first national eye care plan was developed in 2007, low vision was included and the necessary links with education, rehabilitation, and social services were established.

With support from international NGOs and the Ministry of Health (MoH), the strengthening of Sri Lanka's vision rehabilitation services began in 2008. Initially, this involved solidification of the existing tertiary level services, so they could competently provide visual skills training, orientation and mobility training, and counselling services for people with low vision. Following this, ten secondary level clinics, with strong referral links to the three tertiary clinics, were then established within existing district hospitals. Existing eye care practitioners from the eye units of these hospitals were trained to provide the services, including comprehensive low-vision assessment, prescription and dispensing of low-vision devices, as well as training in the use of such devices. People with complicated needs were referred to the nearest tertiary low-vision clinic for further management.

The establishment of these clinics improved the accessibility of vision rehabilitative services across the country and, within only two years following implementation, nearly 8000 people (of whom 10% were children) with vision impairment had received low-vision rehabilitation services. While it is acknowledged that this is a small proportion only of the total number of people with vision impairment in Sri Lanka, it represents a five-fold increase in the number of people accessing low-vision rehabilitation services when compared with the previous three years.

*Adapted from:* Yasmin S. An integrated low vision service: Sri Lanka. Community eye health. 2012;25(77):16.

Table 3.1 Common eye conditions across the life course and the strategies used in response

● strategy is very relevant to the eye condition

● strategy is somewhat relevant.

N.B. Rehabilitation is a type of strategy very relevant for all conditions that cause vision impairment that cannot be treated.

## Common eye conditions amongst children

### Corneal scarring from measles infection and vitamin A deficiency

**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | ● |
| Treatment | ● |

**Common causes:** Vitamin A deficiency and measles infection

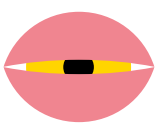
**Can cause vision impairment:** Yes

**Promotion:** Nutrition education regarding a healthy, vitamin A-rich diet, and the importance of measles immunization and vitamin A supplementation

**Prevention:** Measles can be prevented through immunization. It is recommended that children with measles infection should be treated with high dose vitamin A to reduce the risk of corneal ulceration (54). Routine vitamin A supplementation of pre-school-aged children is associated with a clinically meaningful reduction in blindness in children (16, 17). Guidelines for the prevention of vitamin A deficiency recommend that high-dose supplements should be given to children aged 6–59 months in settings where vitamin A deficiency is a public health problem. Large-scale implementation within these settings has been shown to be cost-effective (17). The 2011 WHO guidelines on vitamin A supplementation focus on supplementation and include food-based interventions such as food fortification, to ensure longer-term sustainability.

**Treatment:** In some cases, the vision impairment or blindness caused by the corneal opacity can be treated by an optical iridectomy.

### Corneal scarring from conjunctivitis of the newborn ("ophthalmia neonatorum")



**Type of Strategy**

| | |
|---|---|
| Promotive | N/A |
| Preventive | ● |
| Treatment | ● |

**Causes:** *Chlamydia trachomatis* or *Neisseria gonorrhoeae* infection acquired during childbirth.

**Can cause vision impairment:** Yes

**Prevention:** Ophthalmia neonatorum can be prevented before birth by treating the mother's infection. After birth, the infection can be prevented by ocular prophylaxis (i.e. cleaning the eyelids and instilling an antiseptic or antibiotic shortly after birth).

**Treatment:** Intensive topical and systemic antibiotics

**Retinopathy of prematurity**

**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | ● |
| Treatment | ● |

**Cause:** Abnormal development of the retinal blood vessels in preterm infants.

**Can cause vision impairment:** Yes

**Promotion:** Health promotion regarding the benefits of a course of antenatal steroids for women with threatened preterm delivery *(55)*.

**Prevention:** i) Interventions to reduce preterm birth *(56)*; ii) A course of antenatal steroids to mothers with threatened preterm delivery; iii) High quality neonatal care immediately following birth to address risk factors (e.g. sepsis, poor oxygen management, failure to gain weight, fewer blood transfusions).

**Treatment:** Systematic retinal screening of preterm infants, starting a few weeks after birth, using local, evidence-based screening criteria followed by urgent treatment of infants developing the vision-threatening signs of ROP. Laser treatment significantly reduces the risk of vision impairment or blindness *(32)*. Follow up throughout childhood and adolescence is required to detect and manage complications, such as high myopia.

**Congenital and developmental cataract**

**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | ● |
| Treatment | ● |

**Causes:** Most bilateral cases are of unknown cause. Known causes include intrauterine infection and metabolic disorders, or they are hereditary. Trauma is the most common cause of unilateral cataract.

**Can cause vision impairment:** Yes

**Promotion:** As early surgery gives better visual outcomes, health promotion is required for parents and health workers so that children with signs of cataract (white pupils) are urgently referred.

**Prevention:** Rubella immunization, if this is included in national immunization policies.

**Treatment:** Screening in newborns is recommended to ensure early diagnosis and timely referral for surgery. Cataract surgery requires a well-equipped and competent surgical team *(57-59)*. Following cataract surgery, long-term follow up with optical correction and amblyopia therapy is required *(57)*. Visual rehabilitation may be needed for children with poor visual outcomes.

## Common conditions amongst adults

### Cataract

**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | N/A |
| Treatment | ● |

**Can cause vision impairment:** Yes

**Promotion:** Given the few well-established modifiable risk factors for cataract, including UV-B exposure, cigarette smoking, cortico-steroid use and diabetes, are also associated with other adverse health outcomes, interventions aimed at improving their control should be promoted.

**Treatment:** Treatment involves one-time surgery under local anaesthesia, which can be performed as a day case. Cataract surgery involves removing the opaque lens and implantation of an intraocular lens *(60)*. Surgery at an early stage can prevent worsening of vision impairment or restore vision if undertaken later.

### Age-related macular degeneration

**Type of Strategy**

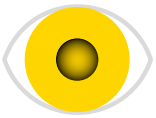
| | |
|---|---|
| Promotive | N/A |
| Preventive | ● |
| Treatment | ● |

**Can cause vision impairment:** Yes

**Prevention:** Cigarette smoking is the main modifiable risk factor. Thus, smoking cessation has been recommended in some clinical practice guidelines for patients who have, or are at risk of, age-related macular degeneration *(61)*.

**Treatment:** There are two types of advanced age-related macular degeneration (AMD) that can lead to vision impairment and blindness, atrophic ("dry") and neovascular ("wet"). Effective therapeutic options, which are currently only available for neovascular AMD, consist of repeated injections of anti-vascular endothelial growth factor (VEGF) agents. Anti-VEGF treatment and monitoring requires optical coherence tomography (OCT) imaging, which are not commonly available in many low- and middle-income countries and there is a paucity of data on the use and effectiveness of anti-VEGF in these settings *(62)*. There are currently no evidence-based treatments for dry age-related degeneration. Life-long monitoring is required.

### Glaucoma



**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | N/A |
| Treatment | ● |

**Can cause vision impairment:** Yes

**Promotion:** Given glaucoma is asymptomatic in the early stages, appropriately designed health promotion initiatives targeting early detection through improved awareness of the importance of regular eye examinations can be effective in increasing the use of eye care services among older populations *(8)*.

**Treatment:** General population screening for glaucoma is not currently considered to be cost-effective in most settings *(63)*. Therefore, routine eye examinations are recommended for high-risk individuals as early detection is essential for the protection of visual function. The only proven, and generally accepted, treatment to reduce the risk of further progression of glaucoma is to lower intraocular pressure *(34)*. Reduction of intraocular pressure can be achieved by a number of interventions including a therapeutic eye drop regimen, laser therapy, surgery, or a combination of these *(34)*.

### Diabetic retinopathy

**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | ● |
| Treatment | ● |

**Cause:** Diabetes

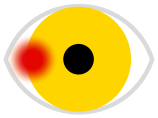
**Can cause vision impairment:** Yes

**Promotion:** Health promotion initiatives can be important to raise awareness of the importance of regular eye examinations among people with diabetes *(7)*.

**Prevention:** After diabetes onset, optimal management of key diabetic retinopathy risk factors (e.g. hyperglycaemia and hypertension) can prevent or delay the onset and progression of diabetic retinopathy *(18, 19)*.

**Treatment:** Given the majority of vision impairment from diabetic retinopathy is avoidable through early detection and timely treatment, periodic screening among individuals with diabetes has long been endorsed. Screening can be undertaken using ophthalmoscopy by trained eye-care personnel (e.g. ophthalmologists or optometrists) or retinal imaging with interpretation. Effective referral and timely treatment of sight-threatening diabetic retinopathy with laser or other interventions is highly effective in preventing vision impairment or blindness *(64)*. Life-long monitoring is required.

### Pterygium



**Type of Strategy**

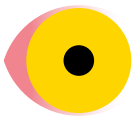
| | |
|---|---|
| Promotive | N/A |
| Preventive | ● |
| Treatment | ● |

**Can cause vision impairment:** In advanced cases

**Prevention:** Avoidance of proposed environmental risk factors may prevent development of pterygium. The wearing of sunglasses may protect against UV radiation, wind and dust.

**Treatment:** Lubricating drops are often used to alleviate symptoms such as irritation and redness. Surgical removal is warranted if the pterygia encroaches on the visual axis (central part of the cornea) *(65)*

### Dry eyes



**Type of Strategy**

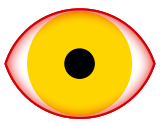
| | |
|---|---|
| Promotive | N/A |
| Preventive | N/A |
| Treatment | ● |

**Causes:** The numerous causes of dry eye include, but are not limited to, contact lens wear, certain autoimmune conditions (e.g. Sjogren's, rheumatoid arthritis), blepharitis, lid disorders, some medications and ageing.

**Can cause vision impairment:** Not typically

**Treatment:** Lubricating eye drops provide the most readily available means of alleviating symptoms of dry eye by increasing the tear volume. In more severe cases, punctal occlusion may be effective in improving tear retention, however evidence is inconclusive *(66)*. When indicated, the appropriate management of lid conditions such as blepharitis (see below) can be effective in reducing dry eye symptoms.

### Blepharitis

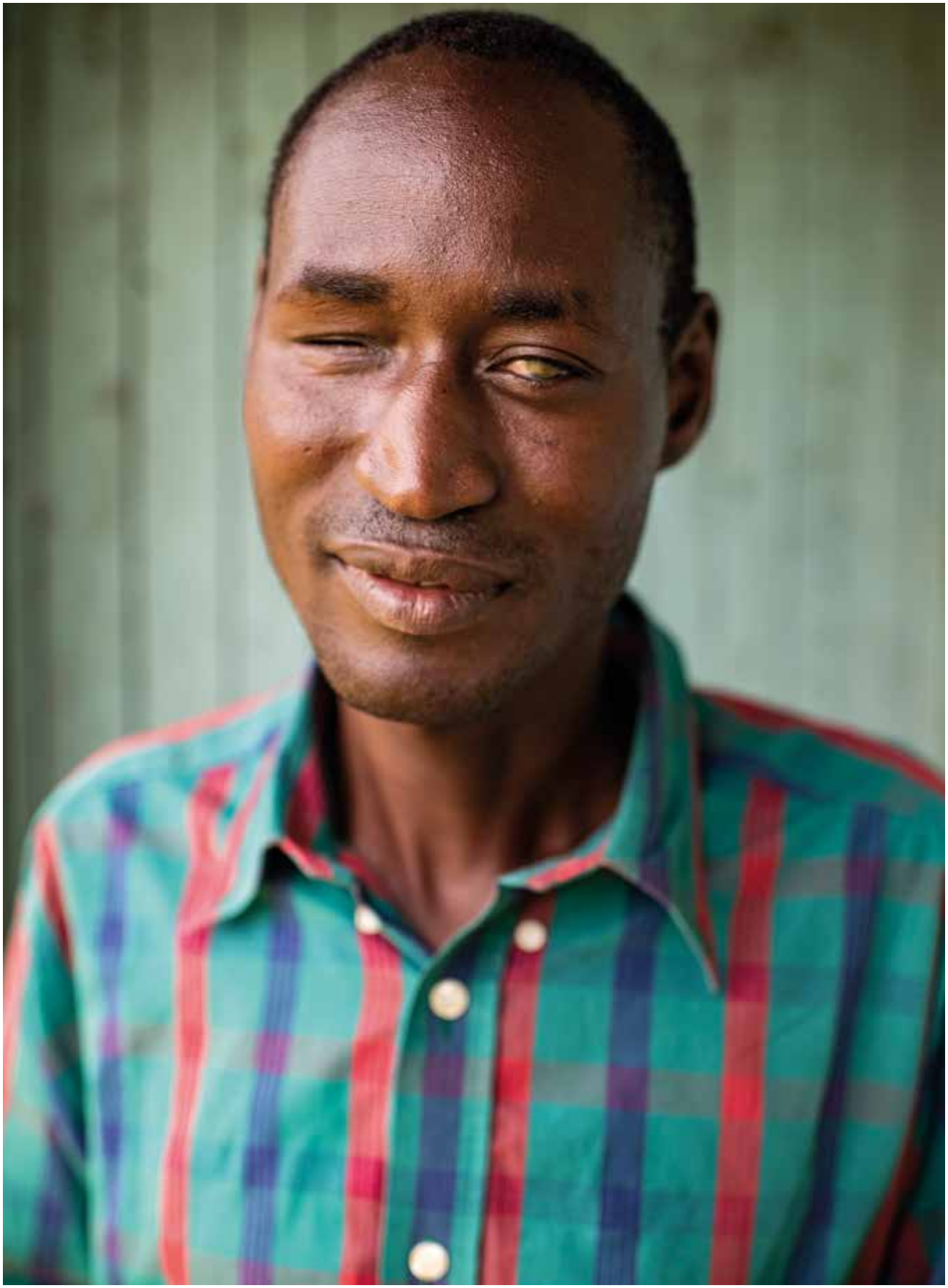


**Type of Strategy**

| | |
|---|---|
| Promotive | N/A |
| Preventive | N/A |
| Treatment | ● |

**Can cause vision impairment:** No

**Treatment:** Blepharitis is usually a chronic condition that cannot be permanently cured. Effective treatment regimens include warm compresses, eyelid cleansing and massage, antibiotics, anti-inflammatory agents, or a combination thereof *(67)*.



## Common conditions among children and adults

### Refractive errors

**Type of Strategy**

| | |
|---|---|
| Promotive | N/A |
| Preventive | ● |
| Treatment | ● |

**Can cause vision impairment:** Yes

**Prevention:** Presbyopia, hypermetropia and astigmatism cannot be prevented. In the case of myopia, on the other hand, increasing children's time spent outdoors and reducing near-work activity might delay the onset and progression of myopia, which reduces the risk of high myopia and its complications *(9, 15)*. There are also a range of optical, pharmacological, behavioural and surgical interventions to delay the onset or slow down the progression of myopia to more advanced forms and severe complications, however further research is required *(68)*.

**Treatment:** Screening for refractive errors is recommended among children (only) in order to avoid the negative impact of uncorrected refractive error on academic performance *(12)*.

Reduced visual acuity from refractive error can be effectively compensated for with spectacles or contact lenses. Laser refractive surgery and, less commonly, intraocular lenses are used to correct the refractive error.

### Corneal opacity due to injury

**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | ● |
| Treatment | ● |

**Causes:** Ocular injury

**Can cause vision impairment:** Yes

**Promotion/Prevention:** Interventions focused on public and occupational safety through regulatory and policy measures, such as wearing seat belts and restricting use of fireworks, can reduce the risk of eye injuries *(20, 21)*. Targeted health promotion to improve awareness of trauma prevention strategies, including wearing of protective eye wear in high risk activities and industries (e.g. certain sports, agricultural activities) may also be effective in reducing eye injuries. However, more research is required to investigate the effectiveness of educational interventions in preventing eye injuries *(22)*.

**Treatment:** In some cases, the vision impairment or blindness caused by the corneal opacity can be treated with a corneal transplant to restore vision. Shortage of corneal tissue is a present challenge.

### Trachoma

**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | ● |
| Treatment | ● |

**Cause:** Infection with the bacterium *Chlamydia trachomatis*

**Can cause vision impairment:** Yes

**Promotion/Prevention:** Antibiotic treatment to reduce the risk of, or clear, ocular *Chlamydia trachomatis* infection *(69)* and Facial cleanliness and Environmental improvements, particularly improved access to water and sanitation, to prevent C. trachomatis transmission *(26)*. Antibiotics, facial cleanliness and environmental improvements are delivered to entire districts in which the prevalence of the active trachoma sign "trachomatous inflammation – follicular" is above 5%.

**Treatment:** Surgery for trichiasis to prevent vision impairment or blindness from corneal opacity.

### Onchocerciasis

**Type of Strategy**

| | |
|---|---|
| Promotive | N/A |
| Preventive | ● |
| Treatment | ● |

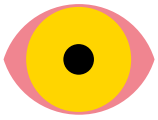
**Cause:** Infection with *Onchocerca volvulus*

**Can cause vision impairment:** Yes

**Prevention:** Onchocerciasis is transmitted by blackflies and can lead to vision impairment and blindness. There is no vaccine or medication to prevent infection. Ongoing onchocerciasis control programmes are implemented in endemic regions and consist of mass drug administration of ivermectin using community-directed treatment. Vector control has been an additional strategy *(13)*.

**Treatment:** WHO recommends treating onchocerciasis with ivermectin at least once annually for 10–15 years *(13)*.

### Conjunctivitis



**Type of Strategy**

| | |
|---|---|
| Promotive | ● |
| Preventive | ● |
| Treatment | ● |

**Common causes:** Allergy or bacterial or viral infection

**Can cause vision impairment:** Not typically

**Promotion/Prevention:** The transmission of viral and bacterial conjunctivitis can be prevented through hygiene measures (e.g. handwashing), while the avoidance of allergens can be effective in preventing allergic conjunctivitis.

**Treatment:** Bacterial conjunctivitis can be treated with antibiotic drops, and allergic conjunctivitis can be treated with anti-inflammatory agents.

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# Chapter 4

# Successes and remaining challenges in eye care

Global concerted action during the past 30 years to address eye conditions and vision impairment has resulted in progress in many areas.

Scientific and technological advances have opened a wide range of clinical and research opportunities that have the potential to accelerate future action.

Moving forward, challenges remain, particularly related to changing population demographics; data collection and its integration in health information systems; integration of eye care in health strategic plans; workforce; and coordination with the private sector.

# Global concerted action

**Global concerted action during the past 30 years has resulted in progress in many areas.**

Thanks to concerted action taken during the past 30 years in addressing eye conditions and vision impairment, and the scientific and technological advances made in the field of eye care, the sector has a strong platform of success on which to build future actions.

## Advocacy

Considerable efforts have been made during the past 30 years to address eye conditions and vision impairment which has resulted in progress in many areas. The global initiative for the elimination of avoidable blindness, "Vision 2020: The Right to Sight" *(1)* was launched in 1999 by WHO to intensify and accelerate activities for the prevention of blindness with the goal of eliminating avoidable blindness by 2020. The initiative has been pivotal in achieving unified and coordinated advocacy for key priorities for action in the field of eye care at a global, regional and national level; it has been also been instrumental in strengthening national prevention of blindness programmes, committees and focal points, as well as supporting the development of national eye care plans and advocating for stronger evidence in the field. Four WHA resolutions adopted in 2003 (WHA56.26), 2006 (WHA59.25), 2009 (WHA62.1) and 2013 (WHA66.11) have maintained this momentum *(2, 3)*.

While the aims and principles of the original initiative have remained the same, they have been built upon with additional plans over the years. The initial Vision 2020 initiative concentrated on the main causes of blindness for which cost-effective interventions were available, such as cataract, trachoma, onchocerciasis and childhood blindness. Subsequently, in recognition of the importance of noncommunicable conditions and the impact milder forms of vision loss on QoL, the 2006 plans focused not only on the elimination of avoidable blindness, but also included vision impairment, particularly the correction of refractive error.

The WHA resolutions of 2009 and 2013 were accompanied by WHO action plans which identified clear objectives and activities for Member States, the WHO Secretariat and International Partners. The most recent action plan, *Universal Eye Health: A global action plan 2014–2019 (3)*, included a further dimension around universal access to comprehensive eye care services and set an ambitious global target to reduce the "prevalence of avoidable visual impairment by 25% by 2019".

Evidence of the impact of these concerted efforts was presented to Member States at the Seventieth WHA in May 2017 in a report highlighting the progress made towards achieving the indicators included within the 2014–2019 global action plan (resolution WHA66.4). At the Assembly, 56 Member States reported having developed a national eye health plan, or strategies supported by the action plan, while many others reflected the action plan within their broader national health plans. More than 50 Member States also reported that establishing a national eye health committee or a similar coordinating mechanism had been critical to implementing the action plan *(4)*.

The consistent call for more evidence on visual impairment and eye care services has led to a significant increase in the number of population surveys undertaken to measure blindness and vision impairment, with more than 60 population-based surveys from 35 countries being conducted since 2010 (and approximately 300 surveys from 98 countries since 1980) *(5)*. Knowledge generated through these surveys has been pivotal to increasing advocacy and informing suitable public health strategies.

## Eye conditions and vision impairment

Substantial progress has been made in addressing specific eye conditions and vision impairment. The number of children and adults with eye infections and blindness due to vitamin A deficiency *(6)*, onchocerciasis *(7)* and trachoma *(8, 9)* has decreased in all regions during the past 30 years *(10)*. This is due to the implementation of large-scale public health initiatives that have led to improvements in hygiene measures, nutrition and immunization coverage, as well as the distribution of antibiotics, ivermectin, and vitamin A. In addition to the successes of the preventive interventions for active trachoma, the number of people worldwide who need operations for trachomatous trichiasis has decreased substantially during the past decade: from 8.2 million in 2007 *(8)* to 2.5 million in 2019 *(11)*.

Cataract is the leading cause of blindness globally and has been a primary focus of many programmes aimed at meeting the Vision 2020 objectives. As a result, many low- and middle-income countries have seen substantial increases in rates of cataract surgery *(12, 13)*. For example, India was successful in increasing its cataract surgery rate by almost nine-fold between 1981 and 2012 *(14)*. These endeavours have resulted in modest reductions in the global proportion of cases of vision impairment and blindness attributable to cataract between 1990 and 2015 *(15)*.

It is clear that investments during the past 30 years have produced considerable dividends, with a recent meta-analysis of population-based studies for the GBD reporting an ongoing reduction in the age-standardized prevalence of distance vision impairment and

blindness among the adult population since 1990 (3.83% in 1990 compared with 2.90% in 2015) *(5)*. Furthermore, modest reductions have been achieved in the proportion of adults with vision impairment or blindness specifically due to preventable or treatable causes *(5)*. It is important to note, however, that reductions in prevalence are not keeping pace with population ageing and growth, thus, the number of adults affected by vision impairment is increasing.

## Scientific and technological advances

Scientific and technological advances have also opened a wide range of clinical and research opportunities in the field of eye care. For example, optical coherence tomography has significantly shaped the clinical practice of eye care during the past 15 years *(16)*, assisting diagnosis of a range of eye conditions and guiding treatment regimens for glaucoma, diabetic retinopathy and age-related macular degeneration. The adoption of telehealth solutions has been effective in improving access to a range of eye care services, particularly for those living in rural and remote areas of many countries *(17–19)*. Several emerging technologies in the field of eye care, including the use of mobile-based software applications for vision assessment *(20, 21)* and cataract surgery benchmarking *(22)*, and artificial intelligence technologies for the detection of a range of eye conditions including diabetic retinopathy *(23–26)*, offer further hope for enhancing access and quality of health care to the most neglected communities. However, further research is required in real-world settings prior to widespread adoption of these technologies. The use of big data analytics also has the potential to improve knowledge of service use and the surveillance and aetiology of eye conditions *(27)*, and for the monitoring surgery outcomes *(28)*.

In the context of treatment, advances in surgical techniques for cataract, coupled with improvements in intraocular lens design and the increased availability of low-cost, high-quality intraocular lenses *(29)*, has led to significant improvements (in terms of the quality of visual outcome of patients, safety and surgical volume) in cataract surgical service delivery *(30, 31)*. The introduction of anti-VEGF injections has revolutionized the treatment of age-related macular degeneration and resulted in a reduction in the incidence of blindness from neovascular age related macular degeneration in high-income countries *(32, 33)*. Nonetheless, while it is clear that both anti-VEGF therapy and optical coherence tomography play a major role in the prevention of blindness, currently their accessibility is scarce in many low- and middle-income countries due to cost implications *(34, 35)*. Scientific advances in treatment for people with human immunodeficiency virus (HIV) has rendered HIV-related ocular infections largely prevented, although immune recovery uveitis has emerged as a complication *(36)*. Further scientific advances in the fields of nanomedicine and tissue engineering

offer hope for improvements in treatment of glaucoma and age-related macular degeneration, and surgery for corneal opacities *(37–39)*.

Technology advances have changed vision rehabilitation. The development of smart phones, voice recognition, and accessibility features in computer operating systems, have dramatically enhanced access to information and communication for individuals with vision impairment and blindness *(40)*. Digital audio books are widely available in increasing numbers for those with print-reading disability. Individuals with vision impairment can navigate using GPS, or use electronic canes to assist in detecting nearby obstacles *(41)*. Although further research is required, retinal implants could potentially offer an innovative solution to restoring sight to those with little functional vision *(42)*.

It is important to recognize that the examples provided here are by no means exhaustive, and as a result of the rapid pace of innovation in the field of eye care, there are likely to be further noteworthy technological advances during the coming decades.

# Challenges moving forward

While it is evident that substantial progress has been made to improve access to eye care services, this has not kept pace with population eye care needs.[1] As outlined in Chapter 2, at least 1 billion people worldwide have vision impairment that could have been prevented or has yet to be addressed. Furthermore, global eye care needs will increase substantially due to increasing urbanization, demographic and behavioural and lifestyle trends.

## Changing population demographics

**Challenges remain in ensuring that quality services are planned and provided according to population needs.**

As described in Chapter 2, the number of people aged 60 years and over is estimated to increase by 54%: from 962 million in 2017, to 1.4 billion in 2030, and to 2.1 billion by 2050 *(43)*. An increase in life expectancy and population growth will compound the situation. Therefore, despite the interval improvements in the age-standardized prevalence of vision impairment described earlier, the combination of a growing and ageing population will significantly increase the total number of people with eye conditions and vision impairment, since prevalence increases as people age *(5)*.

Despite being more feasibly addressed, cataract and uncorrected refractive error remain major items on the unfinished agenda of public health *(44, 45)*. Close to 200 million people worldwide currently have moderate to severe presenting distance vision impairment or blindness caused by cataract or uncorrected refractive error, while an estimated 826 million have near vision impairment caused by unaddressed presbyopia. This figure is expected to increase substantially since cataract and presbyopia development are an inevitable part of ageing. Projected increases in myopia, however, are believed to be driven largely by environmental factors (e.g. decreased time spent outdoors and increased near-work activities).

It is clear that there is a growing need to expand the coverage of interventions for cataract and refractive error in order to meet the current and future demand for these conditions; a report from the United States of America estimated that in order to maintain the current surgical coverage, an additional 4.3 million cataract operations per year will be required by 2036 *(46)*. The main challenges in meeting these

1 Population eye care needs describes the volume and type of need for eye care from all individuals within a given population. It includes the need for eye care across all health strategies, health promotion, prevention, treatment and rehabilitation. The need for eye care can arise from eye conditions that can or do not commonly cause vision impairment, as well as other health conditions that can impact vision function, such as diabetes.

growing demands include the ability to provide access to cataract and refractive services to underserved populations, and ensuring quality of service delivery over time *(47)*. Although increases in cataract surgical rates have been documented in many countries *(12, 13)*, recent evidence suggests that post-operative vision results are, at times, suboptimal *(47)*.

New strategies are also needed to address the challenges related to the rapid emergence of noncommunicable chronic eye conditions, such as diabetic retinopathy, glaucoma, age-related macular degeneration, complications of high myopia and retinopathy of prematurity. In contrast to the single or short-term interventions required for cataract *(48)*, these conditions require a comprehensive range of interventions for their management as well as long-term care which will have a profound impact on an already strained health system and eye care workforce. Based on the projected burden of diabetes alone, it is estimated that, by 2040, there will be a 50% increase in the number of people worldwide requiring access to routine (i.e. yearly or biennially, depending on setting) retinal examination *(49)* for diabetic retinopathy *(50)*.

**In many low-income countries cataract is now the leading cause of addressable blindness in young children, in corneal scarring remains the most common cause of blindness.**

Evidence suggests that current coverage of vision rehabilitation services is poor in most countries *(51)*. The change in population demographics, and subsequent rise in the number of people with vision impairment that cannot be treated, will see an increasing demand for such services. Likewise, the number of people with age-related eye conditions not typically causing vision impairment (e.g. dry eye), but often requiring care due to painful and troublesome symptoms, will increase.

### Changing priorities among child populations

Of importance is the shift in eye care priorities observed among child populations in low- and middle-income countries during the past couple of decades *(10)*. In many, but not all, low-income countries where blindness from corneal scarring has declined due to the successful implementation of public health initiatives, cataract is now the leading cause of addressable blindness in young children. Despite this, due to slower progress in some countries, corneal scarring remains the most common cause of blindness *(52)*. Early detection and referral is essential, and tertiary eye care services for children, which are inadequate in many low-income countries, are required for the surgical management and follow up.

Due to an increase in the number of preterm births, and survival of premature babies, retinopathy of prematurity has also become a leading cause of blindness among children in many middle-income countries *(53)*, and is a newly emerging challenge in several African countries *(54)*. As a result, there is greater need for high-quality neonatal care, and for integrated retinopathy of prematurity screening and treatment services with long-term follow up.

As in adult populations, the number of children and adolescents with refractive error, particularly myopia, is set to increase substantially in coming decades *(45, 55, 56)*. A recent global systematic review and meta-analysis reported that the number of children and adolescents with myopia is expected to increase by 200 million between the years 2000 and 2050. This increase is likely to be more marked in populations undergoing rapid economic transitions (e.g. East Asia) *(55, 56)* and has important implications for planning eye care services.

## Data challenges

This section focuses on the current data challenges in the context of population-based surveys (only). However, it must be acknowledged that the paucity of health services research and implementation research in the field of eye care also hampers the evidence-based planning of eye care programmes and services *(57)*.

**The measure of presenting visual acuity in most population-based surveys does not allow for the total number of people with vision impairment to be calculated.**

As outlined earlier in this chapter, an increasing number of prevalence surveys have been conducted during the past two decades; these have undoubtedly made major contributions towards the understanding of the epidemiology of vision impairment and blindness. Despite these achievements, robust survey data are lacking in approximately half the world's countries *(58)*, with data gaps particularly pronounced in central and southern sub-Saharan Africa, eastern and central Europe, central Asia, and the Caribbean *(5)*. Moreover, of those countries that have conducted surveys, many of their findings remain unpublished *(59)*, and approximately only 15% have national-level data *(60)*. Thus, smaller regional surveys are often used as a proxy to report the prevalence of vision impairment and blindness for the entire country.

As outlined in chapters 1 and 2, there are also a number of gaps in the global epidemiology of eye conditions and vision impairment. Some of these include a lack of reliable global estimates of the prevalence of (i) eye conditions that do not typically cause vision impairment; (ii) having at least one eye condition; and (iii) unilateral vision impairment and blindness.

Furthermore, and importantly, the measure of presenting visual acuity in most population-based surveys does not allow for the total number of people with vision impairment (i.e. for those with met and unmet needs) to be calculated. As a result, the important indicator of "effective" coverage of refractive error correction cannot be reported. While this indicator, along with that of effective coverage of cataract surgery, can potentially be considered to monitor progress towards universal health coverage (UHC, Chapter 5), this will only be possible if data on the total number of people with vision impairment due to refractive error (i.e. without using spectacles or contact lenses to compensate for the condition) are collected, reported and included in the global prevalence estimates (Box 4.1).

**The indicators of effective coverage of refractive error and effective coverage of cataract surgery have been included in the WHO Universal Health Coverage Index.**

**Box 4.1 "Effective" coverage of refractive error and cataract surgery**

The indicators of effective coverage of refractive error and effective coverage of cataract surgery not only capture the magnitude of coverage, but also the concept of "effective" coverage to ensure that people who need health services receive them with sufficient quality to produce the desired gain in vision. Thus, these data are valuable to assess the accessibility and quality of services within a country and should be reported by population-based surveys on a regular basis *(47)*. According to the description included in the WHO UHC Index, the key data points required in the calculation of these indicators include:

*Effective coverage of cataract surgery:*

i. Prevalent cases of operable cataract (i.e. vision impairment or blindness cases where cataract is the main cause).
ii. Prevalent cases of operated cataract (i.e. all those who have undergone cataract surgery regardless of visual acuity outcome).
iii. Prevalent cases of operated cataract and a good visual outcome (i.e. no longer visually impaired following cataract surgery).

*Effective coverage of refractive error:**

i. Prevalent cases of vision impairment and blindness due to refractive error.
ii. Prevalent cases of refractive error with spectacles or contact lenses.
iii. Prevalent cases of refractive error with spectacles or contact lenses and a good visual outcome (i.e. do not have vision impairment when wearing spectacles or contact lenses)

* Refractive errors that are corrected with laser of lens surgery are not currently included in the calculation of effective coverage of refractive error of the WHO UHC Index, as these procedures are not frequently performed in low-resource settings. However, as the field progresses, it is possible for these procedures to be integrated within the calculation.

Several opportunities exist to strengthen the type of data collected and reported, to ensure that the full benefits of undertaking a survey are secured:

**Rapid assessment survey methodologies frequently used in low- and middle-income countries include simplified ophthalmic examinations which makes it difficult to assign a cause to vision impairment and report on the prevalence of many eye conditions.** Historically, rapid assessment surveys have focused on the identification of avoidable causes of vision impairment and blindness, such as cataract, refractive error and corneal scarring. However, due to the projected growth in the number of people with noncommunicable eye conditions such as glaucoma, age-related macular degeneration and diabetic retinopathy in the coming decades, there is a need to improve the ability of surveys to identify these posterior segment conditions.

**Surveys often employ varied definitions for near and distance vision impairment and blindness, making it difficult to compare findings between studies.** For example, the definition of near vision

impairment varies widely between studies in terms of the testing distance and the font size used. Furthermore, surveys conducted in high-income countries frequently employ more stringent visual acuity cut-offs for distance vision impairment. Greater standardization of definitions of near and distance vision impairment is required.

**Most surveys do not incorporate provisions for sample stratification to account for heterogeneous populations.** Assuming homogeneity may result in an insufficient quantification of the burden of vision loss in some of the countries' most vulnerable groups, such as indigenous populations, ethnic minorities, people living in poverty and people with disabilities. To reduce inequality, it is important to identify which subgroups of the population are less able to access eye care services.

**Previous prevalence surveys have infrequently assessed and reported potential non-response bias, making it difficult to interpret the representativeness of the results.** A recent review of 92 blindness prevalence surveys undertaken in low- and middle-income countries and published between 2009 and 2017 *(61)* identified that less than a quarter of researchers report response bias – i.e. the difference between people who participate ("responders") and those who do not ("non-responders") – in ways that affect prevalence estimates.

**There is a paucity of population-based data reporting vision impairment for all ages *(62, 63)*.** To date, the vast majority of survey methodologies have been undertaken for population subgroups aged 50 years and over, due to the fact that an estimated 80% of vision impairment occurs in this age group. Despite this, it is well-established that eye conditions and vision impairment from uncorrected or under-corrected refractive error and diabetic retinopathy is common at much younger ages. In order to target effectively the needs of people at critical periods throughout the life course, epidemiological studies may need to be more inclusive of younger populations. Alternatively, there may be opportunities to include modules on eye care in child health surveys.

Efforts are already underway to strengthen survey designs to address many of these limitations *(64)*; recommended case definitions for near and distance vision impairment have now been included in the 11th Revision of the ICD–11.[2] The field would also benefit from the development of an eye care survey handbook to support researchers in the conduct of epidemiological studies, including the provision of guidance on study design, survey planning and implementation and possible data collection tools, while taking into consideration factors such as complexity and cost. This would ensure that comparable information is collected and reported and would facilitate future estimations of the global prevalence of vision impairment and other important service coverage indicators.

2 See: https://www.who.int/classifications/icd/en/.

## Integration

**Eye care is not typically included in health strategic plans.**

While the 2014–2019 global action plan *(3)* promoted the implementation of integrated national eye health policies, plans and programmes, much needs to be done in countries for effective integration. Strategic plans for eye care are not currently included in health sector strategic plans in most low- and middle-income countries. It can be assumed that if eye care is not included in health strategic plans, it will frequently not be included in the planning and budgeting of services.

*Vertical programmes*

Vertical initiatives tend to be short to medium term and have been successful in some situations, most often where there is infectious transmission of a condition *(65)* or where the existing health infrastructure is so weak that there is nothing on which to build or integrate services *(66)*. For example, vertical (disease-specific) programmes have been used as a common and successful model in eye care for specific conditions such as trachoma and onchocerciasis *(65, 67)*.

**Eye care is not typically included in health strategic plans.**

However, for the most part, these programmes do not address eye care needs across the life course or those associated with ageing and chronic disease; moreover, they appear to have failed to reduce health inequalities between socioeconomic groups in low- and middle-income countries. At times, there may also be perverse incentives that compromise quality and patient safety to achieve high outputs. In addition, vertical programmes can be poorly aligned with population eye care needs *(68–70)*.

Increasing access to services requires renewed efforts to integrate eye care, not only into the planning of the health sector in general, and into specific health programmes in particular (e.g. neonatal care, noncommunicable diseases, primary care and rehabilitation) but also into other sectors, such as education. For example, while there are an increasing number of examples of large scale and effective eye screening exist in the context of school health programmes *(71)*, availability is still lacking in many low- and middle-income countries. In light of the increasing number of children and adolescents with refractive error, high-quality and cost-effective school-based eye-care linked to service provision is of the utmost importance. This requires cooperation between the ministries of health and education, coupled with a national eye-care plan that includes school eye health *(71, 72)*. Although there are some successful examples of eye-care interventions being delivered through other health services *(73)*, to date, progress has been slow in the eye care sector which may reflect a disconnection with the rest of the health system.

**Most eye care delivery focuses on the provision of curative interventions at the secondary and tertiary levels of the health system and is often restricted to urban and larger regional settings.**

*Inequalities in access to eye care services*

As outlined in Chapter 2, persistent inequalities remain between different subgroups of the population in accessing eye care services. In general, those not able to access eye care services as required include people living in rural areas, those with low incomes, women, older people, people with disabilities, ethnic minorities, and refugees. Consequently, they have far higher rates of vision impairment and blindness *(5, 74, 75)*. Despite this, the consideration of equity in eye care plans is currently weak *(76)*. For example, one third of countries (9/27, 59% low income or low- to middle-income) that completed the WHO eye care service assessment tool (ECSAT) between 2014–16 reported that there were no government measures in place to ensure equitable distribution of health workers involved in eye care in all geographic areas.

It is important to note that providing equal rates of eye care services between population subgroups does not guarantee the delivery of equitable services. For example, in many of the world's regions, cataract is notably a more common cause of vision impairment and blindness in women than in men *(15)*. Therefore, as women's needs for cataract surgery are greater, an equal number of operations for women and men would not achieve equity.

Most eye care delivery focuses on the provision of curative interventions at the secondary and tertiary levels of the health system and is often restricted to urban and larger regional settings. This adds to inequity in access to effective interventions for early detection and prevention, and greater costs for patients (e.g. travel costs). To assist in addressing this inequity between population subgroups, there is a need for implementation and health systems research to ensure evidence-based planning of future eye care programmes and services.

There is also evidence demonstrating that eliminating user fees, or reducing out-of-pocket payments at the point of delivery, impacts positively on equitable access to services *(77, 78)*. However, eye care medicines and interventions continue to not be integrated into the health insurance schemes in many low- and middle-income countries. For example, fees for cataract surgery and the costs of spectacles and treatment for noncommunicable eye conditions (e.g. glaucoma, diabetic retinopathy, age-related macular degeneration) continue to rely on out-of-pocket payments in many settings *(79)*. Even high-income countries can require out-of-pocket payments for refractive error assessment and correction, or for the purchase of devices, or specialized insurance for vision care. Furthermore, eye care service delivery is frequently led by charity and nongovernmental organizations that act independently from the MoH.

Some low- and middle-income countries (e.g. India, Viet Nam, Rwanda, Philippines, India) have already included cataract surgery and treatment of other eye conditions in their social health insurance

schemes (Box 4.2). However, given substantial increases in cataract surgical rates, and the associated costs to the health insurance providers, some countries have introduced limits on the total number of surgical procedures claimable per accredited surgeon (Box 4.3). This can be detrimental to improving cataract surgical coverage and emphasizes the importance of a thorough planning process that takes into consideration population needs, projections and workforce availability to estimate the cost and cost coverage.

**Box 4.2 The inclusion of eye care interventions in health insurance schemes in India: the National Programme for Control of Blindness (NPCB)**

*Brief history*

In 1976, India launched its national programme for prevention of visual impairment and control of blindness, currently known as the National Programme for Control of Blindness (NPCB), with an ambitious goal of reducing the prevalence of blindness from 1.4% to 0.3% by the year 2020. Subsequently, a population-based survey conducted in 1986-89 reported a modest increase in prevalence of blindness to 1.49%, with cataract accounting for 80% of blindness cases. On this basis, the Government of India embarked on the World Bank assisted cataract blindness elimination programme targeting seven states (Andhra Pradesh, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu and Uttar Pradesh) where there was a known high prevalence of cataract blindness. This project was highly successful in improving cataract surgery rates (from 1342 per million in 1995 to 3620 per million in 2002) and rates of intraocular lens implantation (increasing from 3% in 1993 to 75% in 2002).

In an effort to decentralize the NPCB, the District Blindness Control Society (DBCS) was formed in each district of India in 1994-95. Subsequent to this (commencing in 2002), the NPCB programme moved to being completely funded by the Government of India without depending on support from external funding agencies. Under this programme, cataract surgery with intraocular implantation is provided free of charge for approximately one third of all cataract surgeries, including all surgeries performed on patients with a poverty certificate. While the initial focus of the programme was on increasing access to cataract surgery with intraocular implantations, funding support was extended in successive years to include a comprehensive coverage of a range of eye care interventions including laser treatment for diabetic retinopathy, glaucoma surgeries, preventions and treatment of ocular trauma, childhood blindness, keratoplasty, squint, vision rehabilitation and screening and lasers for retinopathy of prematurity through successful public–private partnerships. The DBCS reviews the data submitted by the participating hospitals and makes site visits for quality control.

*Progress*

In 2016-17, the NPCB provided cataract surgery to a total 6.5 million people in India, achieving a cataract surgical rate of over 6000 per million population. During this period, school screening was provided to nearly 32 million children and approximately 750 000 spectacles were distributed. In addition, a total of 1.5 million management/treatment procedures were performed for other eye conditions. As a result of these concerted efforts, an overall reduction in prevalence of blindness was reported from 1.1% in 2001-02 to 0.45% during the years 2015–18.

### Box 4.3 Cataract financing under national health insurance – volume, cost control and equity in the Philippines's PhilHealth scheme

In the Philippines, the public health insurance scheme, PhilHealth, covers approximately 90% of the population and is a major source of funding for eye care. Cataract surgery is covered in the benefit package and has long been one of the highest claimed procedures.

Providers are paid a fixed case payment per eye that is the same regardless of the method of cataract extraction (i.e. manual small-incision cataract surgery or phacoemulsification), the type of intraocular lens used (provided it is on the Philippine Food and Drug Administration approved list) and whether the provider is public or private. For senior citizens, the poor and other PhilHealth members whose premiums are sponsored by the government, there is no out of pocket cost to the patient for cataract surgery conducted within government facilities. However, for all other people treated in government facilities, and all of those treated in private facilities, providers can charge above the fixed case payment, with the balance paid by the patient. In the Philippines, 60% of accredited providers are in the private sector.

Significant internal controls are in place for cataract surgery under PhilHealth including pre-authorization requirements, such as verifiable patient information and surgery approval by ophthalmology unit heads. In 2015, the control systems identified unusually high numbers of cataract surgeries being sought for reimbursement. This was driven by some providers seeking to profit from the scheme by providing cataract surgeries that may not have been necessary or that were fraudulent.

In response, PhilHealth restricted the number of cataract surgical procedures claimable per accredited surgeon to 50 per month (not exceeding 10 in any one day), with the exception being when surgery was undertaken as part of a recognized residency training programme. This has resulted in substantially reduced claims for cataract surgery – phacoemulsification surgery, for example, was the 5th highest claimed procedure in 2015 (just over 146 000 claims totalling PHP 2.34 billion) but dropped to 10th position in 2016 (just under 95 000 claims totalling PHP 1.52 billion). The impact of these measures on the provision of equitable access to cataract surgery needs to be investigated.

*Coordination with private sector*

Although the private sector makes up a significant proportion of the provider landscape in the field of eye care, the exact share is rarely understood *(80–82)*. A risk of strong involvement from the private sector and/or nongovernmental organizations is that it may contribute to governments not taking responsibility for the provision of eye care services as part of national insurance schemes, with negative consequences for disadvantaged groups that cannot afford the costs of private service provision. In some circumstances the challenge may be the lack of regulation of private sector services.

**Although the private sector makes up a significant proportion of the provider landscape in the field of eye care, the exact share is rarely understood.**

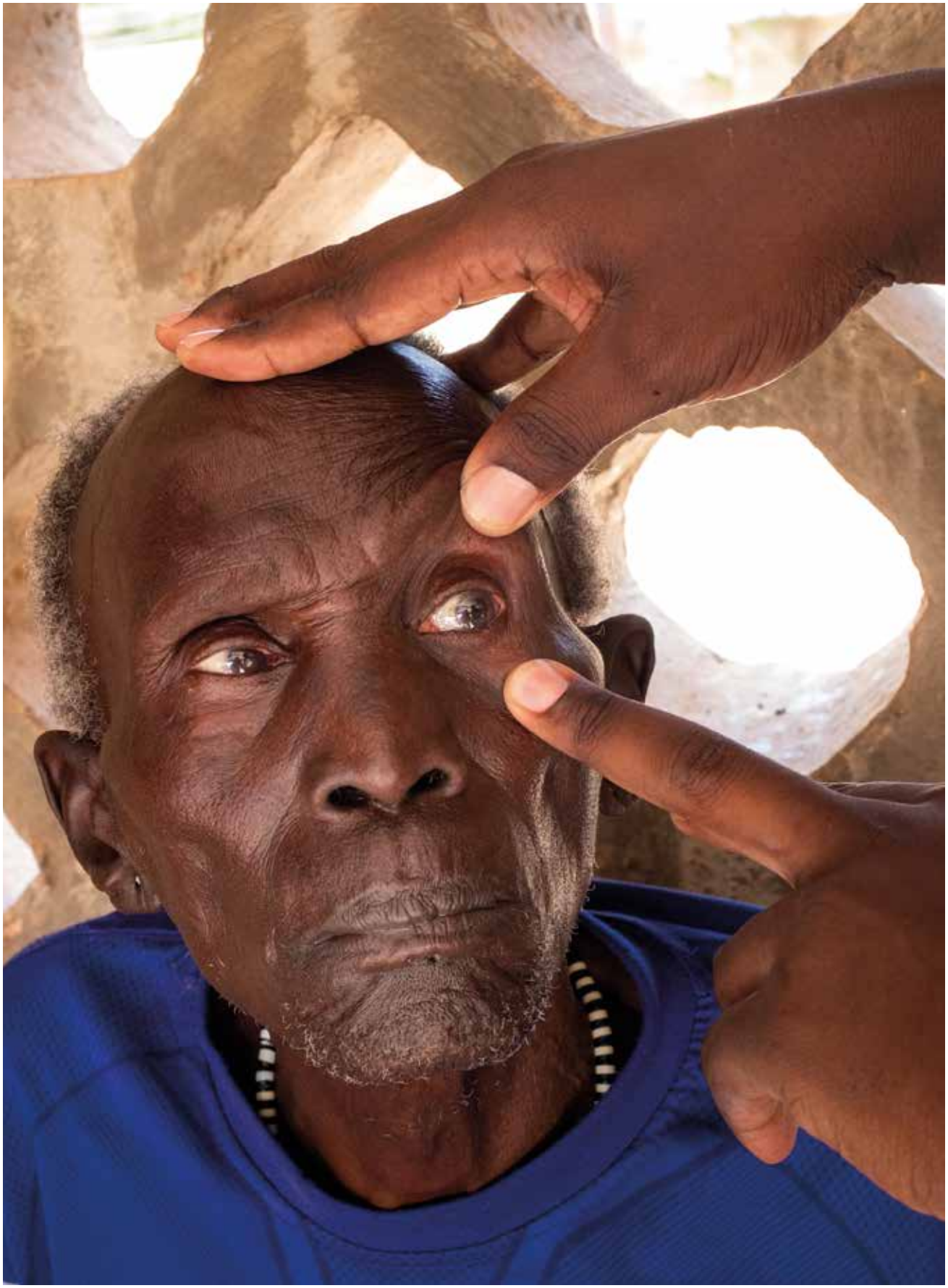
Given the growing demands for eye care services, effective options for public–private partnerships need to be explored as a means to provide affordable eye care *(79, 83)*.

*Uncoordinated and unregulated workforce*

Several factors accentuate the problems associated with the shortage of health workers in low- and middle-income countries; these include suboptimal distribution (both geographically and across income levels), issues with retention, and poor supervision and coordination of eye care services among health workers which can often result in parallel services, overlap, inefficiencies, and gaps, and poor outcomes *(84)*.

While innovative strategies have emerged which use community-based workers and other cadres, such as optometrists, to deliver eye care and vision services, their impact has been hindered by a lack of coordination, regulation and a systematic integration, resulting in persistent service gaps and inequalities and a lack of standardization of care in many low- and middle-income countries. To be successful, such strategies must occur within the context of needs-based workforce evaluation and planning, that aligns the competencies, composition and deployment and retention of the workforce with population needs and distribution.

Despite significant progress being made in the promotion of training standards for optometrists, optometric technicians and optical technicians *(85)*, the acceptance of optometry as a profession remains an issue in many countries and is an important advocacy issue going forward in many countries *(86)*. For instance, of the countries who recently completed the ECSAT tool (2014–16), one-third (8/24) either did not recognize optometry as a profession or there was no established educational requirement for optometrists. In this context it is important to note that, in some countries, productivity may be diminished because a section of the health workforce, such as optometrists, are not accredited to carry out eye care services independently *(87)*.



**HIS often do not include relevant data on eye conditions and vision impairment, their determinants, and health systems data related to eye care.**

*Health information systems*

Health information systems (HIS) are used to collect, standardize, code and manage information relevant to indicators of health status (including eye conditions and vision impairment); determinants of health (including determinants of eye conditions); and health systems (governance and leadership, workforce, essential medicines, technologies and assistive products and service delivery). Such information is needed by (i) policy-makers to identify and respond to problems with evidence-based solutions, and to allocate resources effectively; (ii) planners to design more effective services, and managers to monitor and evaluate these services; and (iii) clinicians to provide high quality and evidence-based care *(88)*. Thus, HIS underpin health and health-related decision-making in health policy, management and clinical care.

Even countries with developed HIS often do not include relevant data on eye conditions and vision impairment, their determinants, and health systems data related to eye care. Consequently, decision-makers at all levels of the health system may lack the information they need to identify problems and needs, to allocate resources optimally or to provide evidence-based services. This can result in a significant gap between what policy-makers, health workers and researchers know and what they need to know to improve the health of the population *(89)*. Furthermore, the situation in eye care is further challenged through the existence of a strong private eye care sector with parallel information systems that do not communicate with public sector information systems.

It is promising that a recent study evaluating 28 national eye care plans from low- and middle-income countries found that almost all countries recognized the need to strengthen their HIS to support the monitoring of eye care services and policy *(76)*. In addition, recent advocacy efforts have also focused on expanding eye care indicators within primary care *(90)*. However, much needs to be done; addressing the challenge of strengthening HIS to include information relevant to eye care is of the outmost importance in the coming years.

## The way forward

The challenges ahead are considerable but can be addressed, especially because the field of eye care can build on its many successes. First, effective interventions are available to reduce the risk of acquiring an eye condition or vision impairment and of mitigating the impact. Secondly, as demonstrated through Vision 2020, eye care can rely on a long tradition of effective and coordinated advocacy that progresses towards common goals. Thirdly, a number of scientific and technological advances have been made with the potential to facilitate early diagnoses and accelerate the response.

In addition, there are also windows of opportunity to facilitate progress, the most relevant being the sustainable development goals (SDGs). Eye care services are particularly relevant to achieving SDG3: "Ensure healthy lives and promote well-being for all at all ages", particularly SDG target 3.8 on UHC: "Achieve UHC, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all". Eye care services also contribute to other targets, such as those on neglected tropical disease (target 3.3), mental health (target 3.4), road traffic accidents (target 3.6), and workforce health (target 3c).

Building on successes, considering the political commitment towards achieving SDG3, and moving forward with UHC, Chapters 5 and 6 describe UHC and IPEC and how each can help address the current and future challenges identified in this chapter. Chapter 5 introduces UHC and its contribution to achieving better integration of eye care into health systems and to reducing inequalities by planning and providing quality eye services according to population needs. Chapter 6 presents IPEC through health system strengthening to address these challenges, particularly those related to the eye care workforce, and the coordination and continuity of eye care.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# Chapter 5

# Advancing universal health coverage through eye care

Eye care is particularly relevant to SDG 3 on health and well-being, and to target SDG3.8 on UHC.

Eye care needs to be an integral part of UHC to address the challenges arising from changing demographics, inequities in access, and lack of integration.

Collecting and reporting information on the met and unmet eye care needs are key for planning services as part of UHC.

Protection against financial hardship involves ensuring that the costs of eye care do not expose the user to catastrophic spending on health.[1]

A package of eye care interventions is needed to facilitate the integration of eye care into the health sector and UHC to effectively meet population needs.

1 Catastrophic spending on health refers to the proportion of the population with large household expenditure on health as a share of total household expenditure or income. Two thresholds are used to define "large household expenditure on health": greater than 10% and greater than 25% of total household expenditure or income. (available at: https://unstats.un.org/sdgs/metadata/?Text=&Goal=3&Target=3.8, accessed 13 September 2019)

# Universal health coverage

Eye care contributes both to the advancement of SDG 3 on health and well-being, and to the target of UHC.

The United Nations (UN) SDGs define targets for priority areas of action that all 191 UN Member States agreed to achieve by 2030. Eye care is particularly relevant to SDG3 which addresses health and well-being, and also to SDG target 3.8 on UHC – an overarching objective towards which health systems should strive. UHC means that all people have access to the health services they need, when and where they need them, without financial hardship. It includes the full range of essential health services, from health promotion to prevention, treatment, rehabilitation, and palliative care *(1)*. Additionally, UHC is a powerful approach to ensure progress in meeting other health-related SDG3 targets.

Debates and actions around the implementation of UHC take into consideration the following issues:

**Make eye care part of universal health coverage.**

- Ensuring coverage of the population – i.e. leaving no one behind;
- Ensuring financial health protection and avoiding catastrophic expenditures;
- Providing a package of high-quality integrated and people-centred health services.

It is important to note that each country may have different starting points and pathways as they progress towards UHC; these will depend upon population needs, available resources, the political and social context, and the maturity of the health system, among other factors. However, to attain the overarching goal of UHC a health system approach is required, whereby all health system components are strengthened to provide comprehensive, quality services. Furthermore, the health sector needs to collaborate actively with other relevant sectors and stakeholders to discuss and agree on potential strategies to improve the population's health.

To address many of the challenges identified in Chapter 4 – particularly those relating to changing demographics, inequities in access, and lack of integration – eye care needs to be an integral part of UHC. However, significant work needs to be done given that priority eye care services are still only provided with out-of-pocket payments in a number of countries.

When considering eye care through the lens of UHC, the knowledge and evidence available to date suggest the following messages for policy makers:

(i) Provide quality eye care services according to population needs to improve service coverage and reduce inequalities. This requires assessments of total population eye care needs (i.e. both met and unmet needs);

(ii) Ensure that the cost of priority eye care interventions are included in service packages covered by pre-paid pooled financing;

(iii) Move towards IPEC.

The first two points are addressed in this chapter; the third, on IPEC and its role in eye care, is introduced in Chapter 6.

## Quality eye care services according to population needs

Highlighting the importance of quality care is not new in the field of eye care; the quality of cataract surgery, for example, has at times been a concern. Thus, in recent years, greater emphasis has been placed on reporting the population-based measure of effective coverage of cataract surgery (see Chapter 4, Box 4.1) in order to understand both the accessibility and quality of cataract surgery within populations *(2, 3)*. Additionally, in the clinical context, there have been successful examples where the introduction of innovative tools to monitor the quality of cataract surgery has resulted in improved safety and outcomes (Box 5.1).

**Collecting and reporting information on the met and unmet eye care needs are key for planning services as part of UHC.**

**Box 5.1 Monitoring the quality and safety of cataract surgery: a case example from Malaysia**

The outcome of cataract surgery is dependent on surgeon skill and therefore monitoring competency is important to ensure patient safety and standard of care. In 2009, an innovative quality monitoring tool, the cumulative sum (CUSUM) analysis, was implemented in the ophthalmology programme in the MoH of Malaysia. The CUSUM is a statistical process control tool that objectively assesses that outcome of consecutive cataract surgery performances over time with reference to predetermined outcome standards.

To date, CUSUM has been applied to close to 1300 ophthalmic trainees and consultants in all hospitals in the MoH of Malaysia (estimated to provide 50-70% of all cataract surgeries in the country) for the occurrence of posterior capsular rupture and a post-operative best-corrected visual acuity of worse than 6/18. If trainees CUSUM charts display an unacceptable level of performance, their supervisors provide feedback and impose closer monitoring of subsequent surgeries.

Evidence of impact of this strategy is available. Between 2007 and 2017, the rate of posterior capsular rupture reduced from 4.2% to 2.4%. During a similar period, a modest improvement in the proportion of patients who had a post-operative visual acuity outcome of 6/18 or better was also observed (96.1% (2007) vs. 97% (2016)).

As demonstrated in Box 5.2, many different characteristics need to be taken into consideration to provide high-quality health services. This will require a more deliberate focus on the quality of eye care services from policy makers in countries. High-quality health services are now generally understood to involve the right care, at the right time, responding to the service users' needs and preferences, while minimizing harm and resource waste. The measurable characteristics essential to quality health-care services include being effective, safe,

and people-centred; to realize the benefits, they should also be timely, equitable, integrated and efficient (Fig. 5.1) *(4)*. An example of how these characteristics can be applied to eye care services for an individual is presented in Box 5.2.

An assessment of the state of the quality of health care requires consensus on the definition and measurement of indicators for quality at a national level, and needs to be comparable across countries. Therefore, for the eye care sector to move forward, output and outcome indicators need to be defined. In addition, structural measures of quality of eye care for service delivery (inputs), including equipment, human resources, incentives and organizational characteristics, will be required (see Chapter 6, Fig. 6.2).

Figure 5.1 Elements of health-care quality in the context of eye care *(5)*

**Box 5.2 Example of how the elements of health-care quality can be applied to eye care services for an individual**

Consider Julie, a woman in her sixties who lives with her husband in a rural location. She was diagnosed with type 2 diabetes mellitus 2.5 years ago and has since attended regular diabetes check-ups at the primary care centre. Her blood sugar levels are currently well controlled with medication. During the past few months, Julie has noticed a gradual reduction in her vision; however she attributes this to "normal" changes associated with ageing. Today, she presents to the primary care centre for the routine assessment of her diabetes. Her vision is also checked, and it is noted that Julie has reduced visual acuity in both eyes; her right eye being worse than her left. She is immediately referred to the local eye care provider where she is diagnosed operable cataracts. A thorough retinal examination does not reveal signs of sight-threatening diabetic retinopathy.

The following points illustrate the high-quality care that Julie would receive within the framework of the seven key elements of quality.

- **High-quality care for Julie is people-centred:** the care Julie receives would respect her preferences, needs and values. Julie may understandably be worried and ask many questions. The health-care workers attending her would listen to her questions and concerns, answer patiently, and provide both oral and written information about all aspects of treatment tailored to her needs. The health-care services would be located near to where Julie lives, and she should only be required to travel a further distance for her cataract surgery.
- **High-quality care for Julie is equitable:** the services received by Julie, including the timing of services, would not vary according to her personal demographics (e.g. gender, race), the geographical location in which she resides, or her socioeconomic status.
- **High-quality care for Julie is effective:** the care Julie receives would be based on scientific knowledge and evidence-based guidelines *(6)*. Julie would be reassured that she would receive evidence-based care and that a systematic process would be followed. She would be informed that her cataract surgery should be successful in achieving the desired visual outcome, and that any residual post-operative refractive error or other complications that may impact on vision (i.e. posterior capsular opacity) would be addressed in a timely manner.
- **High-quality care for Julie is safe:** the care Julie receives would minimize harm, including preventable surgical complications and medical errors (e.g. wrong lens implant). Clear guidelines to prevent infections (e.g. endophthalmitis) and medical errors would be in place in the health facility. A thorough review of her medications and allergies would be made, and clear instructions would be given as to how to care for her eye after cataract surgery and when to return for post-operative assessment. In order to minimize the potential for non-attendance at postoperative and subsequent follow-up visits, a specific, identifiable point of contact may be assigned to Julie. Full consideration would be given to the prevention and management of any potential increased risks of surgery related to her diabetes (i.e. post-operative macular oedema); Julie would undergo detailed retinal examination post-operatively to check for signs of

progression of diabetic retinopathy and, if necessary, treatment would be based on clinical guidelines *(7)*.

- **High-quality care for Julie is timely:** Julie's care would keep to a minimum any delays in the provision of services. Timely cataract surgery would be important to allow Julie to function effectively and to maintain adherence to her prescribed diabetic medication regimen. Additionally, it would be important for surgery to be undertaken before the lens opacities obscure the view of her retina, thereby prohibiting assessment of diabetic retinopathy. With proper planning, Julie would not have to experience long waiting times during post-operative follow-up visits. Contact with other health providers involved in her care, such as those required for routine diabetic retinopathy examinations, would be managed by an efficient patient flow system for scheduling or modifying visits and for notifying patients of projected waiting times.
- **High-quality care for Julie is integrated:** the care Julie receives across facilities and providers would be coordinated. Following cataract surgery, she would continue her regular diabetes check-ups at the primary care centre so that her diabetes could be managed. Arrangements would be made for her to undergo regular monitoring of her retina to check for signs of diabetic retinopathy progression; the timing of this would be based on clinical guidelines *(7)*. A social worker would be available to help connect her with the required services.
- **High-quality care for Julie is efficient;** the care Julie receives would avoid a waste of resources. In order to prevent repetition and waste of resources, each of her health providers would be able to track the results of her previous examinations and procedures via an electronic medical record system. Her care would be provided by a cohesive team, with each member working on tasks that match their competencies.

Beyond understanding and monitoring quality, data on population needs for eye care are essential for planning eye care services as part of UHC. These data can best be derived from population-based surveys. As discussed in Chapter 6, to strengthen data collection, these surveys need to be an integral part of HIS.

As outlined in Chapter 4, population-based surveys not only need to provide information on both met and unmet needs for eye care, they must also allow for disaggregated results for subpopulations, such as women, ethnic minorities and indigenous groups. This information should drive eye care planning to reduce inequalities. Overall, priorities should be determined based on population needs; and should not be determined on an ad-hoc basis according to non-transparent factors such as the visibility of certain conditions, a professional's scope of practice or the priorities of development partners or funding bodies. Examples of initiatives introduced to reduce gender inequality are presented in Box 5.3 and Box 5.4.


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Community consultations also provide an important source of information on the eye care needs of populations *(1)*. Consultations are a concrete way in which the public can be engaged in the development of national health plans that, ultimately, affect them, and where they can provide feedback. These consultations improve accountability and transparency and increase the sense of ownership and engagement of the population – especially marginalized groups – transforming them into active stakeholders. This is particularly relevant to eye care, given that some marginalized groups are unequally impacted by eye conditions and vision impairment, and also because eye conditions, in general, are common and have a well-demonstrated impact on individuals over their life course.

**Box 5.3 Reducing gender disparities in service uptake by pastoral communities in Kenya**

The Coordinated Approach to Community Health (CATCH)[2] project builds on trachoma initiatives to ensure that eye conditions, including cataracts and refractive error, could be diagnosed at trachoma screening clinics, and patients referred and treated. In Kenya, the project predominantly targets poor and marginalized pastoral communities in arid and semi-arid areas.

In these communities, women often experience additional cultural barriers in accessing health services. To address this, CATCH employs strategies to target women, including training female Community Health Workers (CHWs) to mobilize women to attend eye camps, and to engage women who have successfully undergone eye surgery as "Ambassadors of Hope". Women are targeted at strategic locations (e.g. maternal health clinics), and eye screening is carried out at common meeting areas such as water points and markets. Direct targeting also involves door-to-door screening.

By taking services out to remote areas with no health facilities, CATCH enables those women seeking care to remain in their environment, thus causing less interference to their daily responsibilities. Where services are available in a static health facility only, CATCH provides transport to facilitate logistics and reduce costs.

CATCH Kenya achieved a high level of participation of women from the beginning of the project. In the first year, 54.3% of people screened at the CATCH camp were women; this had risen to 58.7% in the third year. The percentage of women receiving surgery for cataracts followed a similar trend. The exception was in the provision of spectacles for reading, where the number of men was consistently higher. Some women perceived spectacles to be for reading only, and as most could not read, had minimal need for these. The demand for spectacles by women increased, possibly because women realized their use for seeing near objects and working with handicrafts. By the third year, half of the spectacles distributed in CATCH camps were to women, which was an encouraging development.

2 District Comprehensive Eye Care (DCEC) project is funded by Seeing is Believing, Standard Chartered Bank's global community investment programme.

### Box 5.4 Gender disparities in uptake of cataract surgical services in Khyber Pakhtunkhwa province, Pakistan

In Pakistan, cataracts are the major cause of blindness, despite being treatable with a straightforward and cost-effective surgery. A Rapid Assessment of Avoidable Blindness (RAAB) survey undertaken in the Khyber Pakhtunkhwa province[3], revealed that prevalence of blindness caused by un-operated cataract was 6.5% in women above 50 years of age, compared to 2% in men; and the cataract surgical coverage for women was considerably lower than for men (75% versus 94%).

To explore the reasons for the lower uptake of cataract surgeries by women, focus group discussions were held with female health workers and beneficiaries. These identified cost and logistics of travel as major barriers to accessing services. Many women did not have access to family finances to pay for surgery and travel costs. Women also had less access to information about treatments, due to lower literacy rates, and many saw cataracts as an inevitable consequence of ageing.

Strategies were introduced to target women and make services in Khyber Pakhtunkhwa more gender-sensitive. Partnering hospitals have introduced gender-focused patient satisfaction surveys, and the number of female eye care workers will be increased. To strengthen the referral chain, more female health staff and paramedics will be trained to screen and refer women to hospitals, and female mid-level eye care staff will be trained in partnership with the Pakistan Government. Awareness and information about free cataract surgeries will be spread to better target female audiences including partnerships with women's organisations and audio and video messages on media networks.

Preliminary data shows encouraging trends and it is expected that these strategies will progressively increase the proportion of women accessing cataract services over the three years of the project. The output targets have been discussed with implementing partners and will be closely monitored.

3 Sightsavers' District Comprehensive Eye Care (DCEC) project is funded by Seeing is Believing, Standard Chartered Bank's global community investment programme.

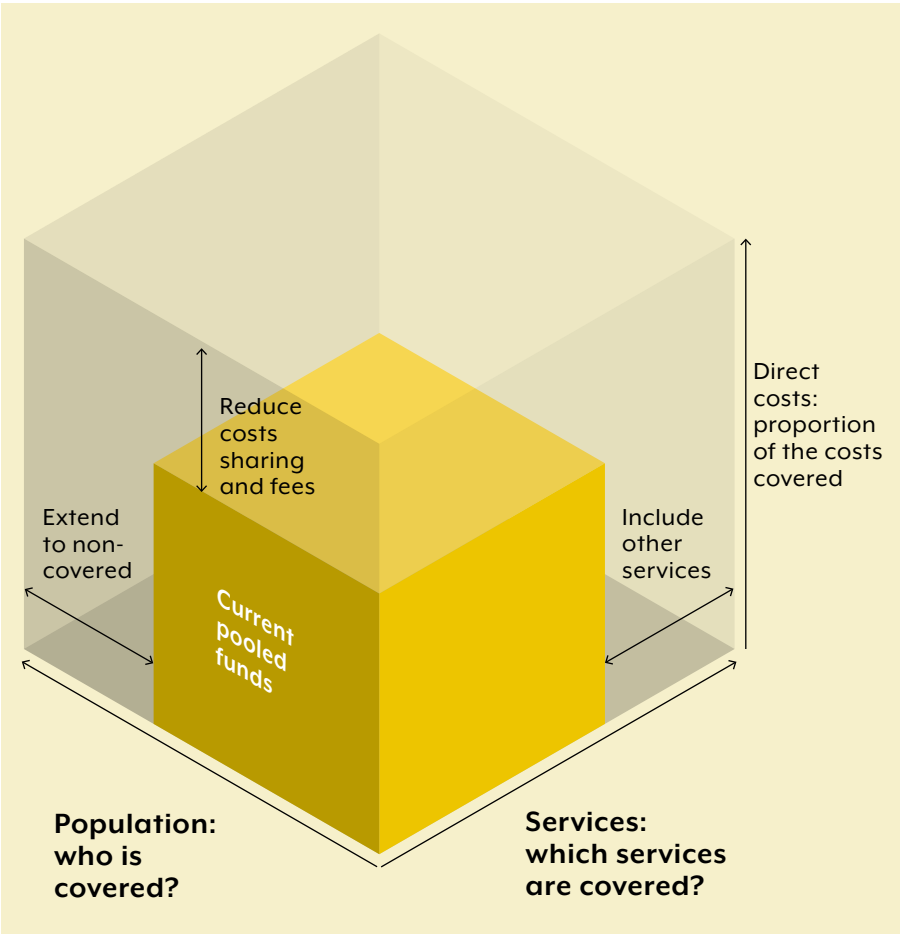
## Ensuring that costs are not a barrier to eye care

Protection against financial hardship means ensuring that the cost of eye care does not expose the user to catastrophic expenses.

As outlined in Chapter 2, the costs of attending eye care services pose a significant barrier to access and can severely limit the well-being and life opportunities for individuals, and their families. An important component of UHC for eye care, therefore, is that all people obtain the eye care services they need without risking financial hardship from unaffordable out-of-pocket payments *(8)*.

In general, and as suggested by the 2014 report of the WHO Consultative Group on Equity and UHC *(9)*, to achieve UHC, countries need to advance in three dimensions (Fig. 5.2). First, priority services need to be expanded; secondly, more people need to be covered; and thirdly, out-of-pocket payments need to be reduced *(1)*. In addressing these dimensions, countries need to make important choices including: which services should be covered first; who should be prioritized; and how can out-of-pocket payments be shifted towards prepayment. For example, should interventions, such as the provision of spectacles, be prioritized over interventions needed for a smaller proportion of the population, such as trachoma? Should interventions for eye conditions that affect children be prioritized and included early on in the package, or should they be postponed for a later stage when more resources will be available? Is it possible to effectively work with NGOs for a limited period of time in order to increase the volume of certain interventions, such as cataract surgery?

Figure 5.2 Dimensions of universal health coverage *(1)*




When selecting services, it is useful to adopt three categories of priority: high, medium, and low. Classification of services into these three categories should be based on locally determined criteria, which may include cost-effectiveness, priority to those who are financially worse off (equity), and financial risk protection. When deciding on which services to expand, a useful starting point is, again, cost-effectiveness estimates, integrating these with concern for the financially worse off, and other criteria, such as safety, and health system capacity. The specification and balancing of these criteria need to be guided by robust public deliberation and participatory procedures.

The eye care sector is well positioned to engage in an evidence-based dialogue given that many eye care interventions are highly cost-effective and feasible to implement *(10-13)*. When deciding on extending population coverage for a given set of services, low-income groups, rural populations, and other disadvantaged (in terms of services or health) groups should be prioritized.

Health care is funded by a range of sources, including government budgets, social health insurance agencies, and households. While the median out-of-pocket spending on health represents less than 20% of

**A package of eye care interventions is needed to facilitate the integration of eye care into the health sector and UHC to effectively meet population needs.**

total health spending in high-income countries, it accounts for more than 40% in low-income countries *(14)*. Out-of-pocket spending is a barrier to accessing health services, especially for those who are poor, and can be a substantial financial burden on those who use the services and their families. Out-of-pocket payments for health services push 100 million people into extreme poverty every year *(14)*. To improve access with financial risk protection, countries should therefore shift from out-of-pocket payments towards mandatory prepayments with pooling of funds. While this may be difficult for some countries, precedence should always be given to high-priority services and disadvantaged groups, including those who are poor. In the case of insurance and other mandatory arrangements for prepayments, countries should ensure that the inability to pay is not a barrier to coverage.[4]

To facilitate the choices that countries must make when implementing UHC, WHO is developing an online data repository detailing WHO-recommended interventions and their resource implications. The repository is intended as a global resource to facilitate discussions at country level around what services to provide within health benefit packages. The database will contain information on service delivery implications, health workforce requirements, essential medicines and devices, with links to overall WHO recommendations and guidelines. The global database will be accompanied by extensive guidance on how to carry out a country local contextualization processes to drive country impact, building on existing WHO tools – such as the WHO OneHealth Tool (Box 5.5) – and further expanding existing guidance. The repository will include information on a recommended package of eye care interventions (Box 5.6). The enhanced access to evidence and recommendations, and the accompanying country level tools, will support MoH in planning, budgeting, and integrating eye care interventions to their national health services packages and policies, according to population needs and available resources, and thus, ultimately contribute to moving forward the agenda of eye care as part of UHC.

### Box 5.5 The OneHealth Tool

The OneHealth Tool is a software tool designed to inform national strategic health planning and costing in low- and middle-income countries.

The OneHealth Tool considers the demands on the health system, whether from a health-system-wide perspective or a programme-specific perspective. It provides a single framework for planning, costing, impact analysis, budgeting and financing of strategies for all major diseases and health system components. The tool is prepopulated with defaults for disease prevalence and incidence; intervention protocols for promotive, preventive and curative care; and prices of drugs, supplies and equipment – all of which can be changed by the user.

*Outputs from an application can help planners answer the following questions:*

- What would be the health system resources needed to implement the strategic health plan?
- How much would the strategic plan cost, by year and by input?
- What is the estimated health impact?
- How do costs compare with estimated available financing?

The tool is designed for use by experts involved in national health planning, including government health sector planners, disease-specific programme planners, NGOs, donors, UN agencies, researchers and consultants. Since its release in 2012, the OneHealth Tool has been applied in more than 40 countries.

Interventions for eye care will be added to the OneHealth Tool in 2020.

### Box 5.6 Development process of the package of eye care interventions

WHO is developing a package of eye care interventions to facilitate the integration of eye care into the health sector and into UHC. The package will provide a set of evidenced-based and cost-effective interventions including the resource requirements for those interventions such as assistive products, equipment, medicines, consumables and workforce competencies.

The process of developing the package starts with selecting a range of priority eye conditions based on global epidemiological data and proposals from experts in the field. For example, if glaucoma is one of the conditions selected, working groups, comprising clinical and academic experts in the field, will then identify evidence-based interventions for glaucoma by drawing on a range of sources including high-quality clinical practice guidelines and systematic reviews. Following this, a professional working group from each world region will engage in a three-step process towards developing a list of interventions for glaucoma. Once the list has been confirmed, working group members will agree on the appropriate service delivery platform for each intervention (i.e. primary, secondary of tertiary). Finally, the resources required for each intervention will be defined and the final package will undergo a thorough peer review process.


*Adapted from:* Rauch A, Negrini S, Cieza A. Toward strengthening rehabilitation in health systems: methods used to develop a WHO package of rehabilitation interventions. Archives of physical medicine and rehabilitation. 2019.

Some countries, such as Cambodia, Kenya, Mali and Morocco, have recently taken significant steps towards implementing UHC, including eye care, despite significant resource constraints. For example, Cambodia has already established their priority eye care interventions within the context of their essential package of health services (Box 5.7). Despite this, it remains that a considerable number of countries globally do not include eye care services as part of UHC – of 29 countries (59% low-income or low- to middle-income) that completed the WHO ECSAT between 2014 and 2016, more than 20% reported that health insurance schemes did not cover any eye care services; several other countries reported that eye care services were only minimally covered.

**Box 5.7 The inclusion of eye care in health sector strategic plans: a case study from Cambodia**

In Cambodia, the MoH has adopted a robust process to inform eye care service planning. Since 2008, eye care has been routinely included as a priority in the Cambodian national health strategic plans. In 2015, the MoH commenced development of the current health plan (2016–2020). The planning process included projecting the estimated costs of activities and targets within the strategic plan, in order to inform priority setting and resource mobilisation. As part of this activity, costs associated with providing eye care services were estimated.

This process required defining the resources, or inputs, associated with eye care, estimating the average cost for priority interventions, and projecting the total number of these priority interventions that needed to be provided each year, as well as the costs associated with running the overall programme, including activities such as monitoring and evaluation. This process enabled the MoH to assess the resources needed to meet national targets for eye care which informed the development of the national eye care plan (National Strategic Plan for Blindness Prevention and Control 2016–2020).

The national plan includes comprehensive objectives that cover many aspects of strengthening health systems, such as workforce requirements. It also provides a high degree of detail, specifying activities, outputs, time frames, responsible agencies, targets, indicators and associated costs.

In summary, the provision of good quality eye care, in accordance with population needs, reduces health inequalities; however, reliable information about population needs are essential. UHC requires that each country expands priority eye care services; that more people are covered; and that the costs of eye care will not expose individuals to catastrophic out-of-pocket expenses. WHO is currently developing a package of eye care interventions that, in combination with other tools – in particular, the OneHealth Tool – will support countries in meeting these challenges.

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# Chapter 6

# Integrated people-centred eye care

Integrated people-centred eye care provides a continuum of health interventions that address the full spectrum of eye conditions, according to people's needs and throughout their life course.

The implementation of integrated people-centred eye care requires four strategies:

1. Empowering and engaging people and communities;
2. Reorienting the model of care;
3. Coordinating services within and across sectors; and
4. Creating an enabling environment

# Integrated people-centred eye care

Building on WHO's existing Framework on integrated people-centred health services *(1)*, IPEC is defined as services that are managed and delivered so that people receive a continuum of health interventions covering promotion, prevention, treatment and rehabilitation, to address the full spectrum of eye conditions according to their needs, coordinated across the different levels and sites of care within and beyond the health sector, and that recognizes people as participants and beneficiaries of these services, throughout their life course.

## Achieving IPEC requires four strategies

WHO's commitment to the Framework on integrated people-centred health services has been adapted to eye care because, as described in Chapter 4, the challenges facing health services that motivated their development, are characteristic of the eye care sector: eye care services are inequitably distributed, of unequal quality and poorly integrated across related health programmes and sectors; and these services are often provided by an uncoordinated and, at times, unregulated workforce. Furthermore, there is a lack of integration of eye care related information in HIS. IPEC has the potential to overcome these challenges and to facilitate approaches to service delivery that respond to emerging health challenges in the eye care sector, including unhealthy lifestyles, ageing populations, and the need to address a range of noncommunicable eye conditions.

Achieving IPEC by adapting the Framework of integrated people-centred health services to eye care, requires the following four strategies:

1. Empowering and engaging people and communities;
2. Reorienting the model of care;
3. Coordinating services within and across sectors; and
4. Creating an enabling environment

This chapter provides high-level guidance on these four strategies for the eye care sector. It is acknowledged that countries may have different starting points when implementing these strategies, depending on the maturity of their health system, resources available, and local needs.

## Empowering and engaging people and communities

As identified in the Framework for integrated, people-centred health services, empowering and engaging individuals, families, communities and care-givers to become effective users of health services requires the provision of opportunities, skills and resources, and advocating for a reformed health system to enhance health care experience and outcomes. Underserved and marginalized populations must be reached in order to guarantee universal access to quality services that are co-produced according to their specific preferences and needs. In order to tailor these requirements to address eye care, countries must build targeted policy options and interventions.

Health literacy is an essential component of empowering individuals and their families; it is crucial for the effectiveness of many eye care interventions and, more generally, for compliance *(2-4)*. The vast majority of cases of vision impairment caused by common eye conditions, such as diabetic retinopathy and glaucoma, are avoidable with early detection and timely intervention *(5-7)*. However, a large proportion of individuals remain undiagnosed because these conditions are often asymptomatic in their early stages; awareness of the importance of regular eye examinations among high-risk populations (such as the elderly and those with diabetes) is largely lacking. In some situations, inadequate knowledge of the availability of services, along with a tendency for individuals to consider reduced vision as part of the normal ageing process, can also lead to poor outcomes *(8)*. Furthermore, even when individuals are aware having an eye condition, poor eye health literacy can limit adherence to medications and routine assessment *(3, 4, 9)*.

**The eye care sector needs to increase its efforts to provide sound, and effective education.**

The eye care sector needs to increase its efforts to provide sound, and effective education. Strategies for engagement and empowerment can occur at the individual or specific population group level. One of the examples of effective community empowerment in the field of eye care is the community-directed treatment with ivermectin as a preventive intervention for onchocerciasis (Box 6.1).

**Box 6.1 Community-directed treatment with ivermectin (CDTI) for the prevention of onchocerciasis**

Onchocerciasis is transmitted by blackflies and can lead to vision impairment and blindness. Ivermectin is an effective and safe medicine for the mass treatment of onchocerciasis. Mobile teams of health workers faced a range of challenges with initial methods of ivermectin distribution including low coverage, minimal community involvement, and high costs to the health system. In 1995, the African Programme for Onchocerciasis Control (APOC) was established. APOC's strategy of community-directed treatment with ivermectin (CDTI) was formally adopted in 1997 after a multicountry study demonstrated that community-directed treatment was a feasible, effective and sustainable approach *(10)*.

CDTI focuses on empowering communities to take responsibility for ivermectin delivery – i.e. putting the community in charge of deciding how, when and by whom ivermectin distribution should take place. This strategy has resulted in substantial achievements for onchocerciasis control in Africa:

- Over 142 million people received treatment for onchocerciasis by the end of 2017. In the same year, fourteen countries reported having achieved 100% geographical coverage.
- Over 17 million disability-adjusted life years (DALYs) have been averted *(11)*.
- By 2005, the prevalence of infection had declined to about 73% of its level prior to CDTI and was estimated to decline to 14% of the pre-CDTI level by 2015.

**Outreach eye care services have been shown effective in increasing service coverage in hard-to-reach communities**

Eye care literacy must target raising awareness of the availability of vision rehabilitation. Many individuals with severe vision impairment and blindness that cannot be treated may live in situations of dependency because they or, their family and community, are unaware that rehabilitation services can be provided to achieve independence. If these services are unavailable, health literacy can engage people to advocate for them.

Information technology has introduced new solutions to overcome the challenge of timely information exchange and health education, the eye care sector must take advantage of this technology. For example, routine mobile text messages have been shown to increase the rate of attendance at eye care facilities *(12)*. The use of electronic health records, and ensuring that patients have easy access to their records, are additional ways of strengthening communication between eye care patients and providers *(13-15)*.

Outreach eye care services have been shown effective in increasing service coverage in hard-to-reach communities, enabling greater responsiveness to local community needs *(16, 17)*. When implementing eye care programmes, it is important to ensure that they are an integral part of the health sector service delivery system, both for sustainability and because new avenues of delivery of eye care interventions can then be explored. For example, eye care interventions, such as screening, can

be integrated into the delivery systems of existing health interventions, such as for vaccines.

To simplify access to care for underserved populations, rapid technological change also has potential. As described in Chapter 4, telehealth is employed effectively in the field of eye care. Telehealth supports people in rural and remote settings who are otherwise underserved *(18, 19)*, and facilitates care coordination between care providers (Box 6.2).

**To simplify access to care for underserved populations, rapid technological change has potential.**

### Box 6.2 Engaging rural and remote communities through telehealth: a case example from Lions Outback Vision, Australia

Teleophthalmology, particularly real-time video consultations, holds great potential to improve the accessibility of services in countries where geography, population and workforce distribution make it difficult to provide specialist eye services outside of major cities. Ophthalmology is particularly suited to telemedicine due to its high reliance on imaging for the diagnosis and management of ocular disease.

*Overview of the service*

Since 2011, Lions Outback Vision (LOV) – part of the Lions Eye Institute – has provided a state-wide teleophthalmology service, linking patients in rural and remote communities of Western Australia to consultant ophthalmologists based in the state capital city, Perth. The distance from Perth to the furthest community in the service is over 3000 km. Referrals to the service originate from optometrists working within regional communities, with rural hospital emergency departments and general practitioners often referring patients for optometric review. The service provides a combination of "store-and-forward" and "real-time" telemedicine links, with results of ophthalmic investigations being sent to the treating ophthalmologist prior to a real-time video consultation. Patients who require ophthalmological clinical assessment or surgical management are provided with an appointment at an upcoming LOV outreach visit.

Following advocacy and a demonstrated evidence base, government health insurance rebates were introduced for optometrists and general practitioners to support telehealth in 2015. There are minimal additional infrastructure costs, given that ubiquitous platforms such as Skype or FaceTime are used for video-consultations. Currently, 94% of all optometrists in the regions visited by LOV actively participate in the telehealth service. The provision of both an online booking system and availability for "on call" urgent assessment reduces barriers for uptake.

*Key outcomes*

Following implementation of the LOV telehealth service, the non-attendance rate at outreach service visits has decreased from approximately 50% to 3%. Patients also demonstrated very high satisfaction with the telehealth service.

The provision of video consultations that include patient consent, and booking, for surgery has resulted in several key outcomes. Firstly, it has eliminated the "wait for the waiting list", where patients can wait for up to one year for a public service outpatient appointment prior to being placed on the waiting list for surgery. In addition, the efficiency and impact of outreach ophthalmology services has improved significantly – a higher proportion of primary eye care is being appropriately managed by optometry with less duplication of services, and a marked increase in surgical management by LOV ophthalmologists.

## Reorienting the model of care

Reorienting the model of care involves ensuring that efficient and effective health-care services are designed and provided by means of innovative models of care that prioritize primary and community care services and the co-production of health. The Framework on integrated people-centred health services defines service priorities based on life-course needs, and building a strong PHC. Strong PHC, with integrated eye care, is important since eye care involves both the delivery of interventions aimed at the individual through primary care (e.g. diabetic retinopathy screening) and population-based interventions, such as the provision of vitamin A supplementation.

**Strengthening eye care in PHC requires adequate funding, appropriate workforce training, a sustainable workforce.**

During this century, building or strengthening PHC, and integrating eye care, is vital for a number of reasons. First, PHC makes it possible for health systems to adapt and respond to changing population demographics and lifestyle changes and the increasing number of people with eye conditions and vision impairment. Secondly, PHC promotes access to services across the continuum of care, while facilitating the use of health promotive and preventive services that are often more cost-effective than treatment services. Finally, PHC is critical to sustainably addressing other key components of UHC such as (i) reducing household expenditure by emphasizing population-level services that prevent eye conditions and promote early detection and timely referral; and (ii) reaching remote and disadvantaged populations through a focus on community-based services that are provided as close as feasible to people's homes *(20)*.

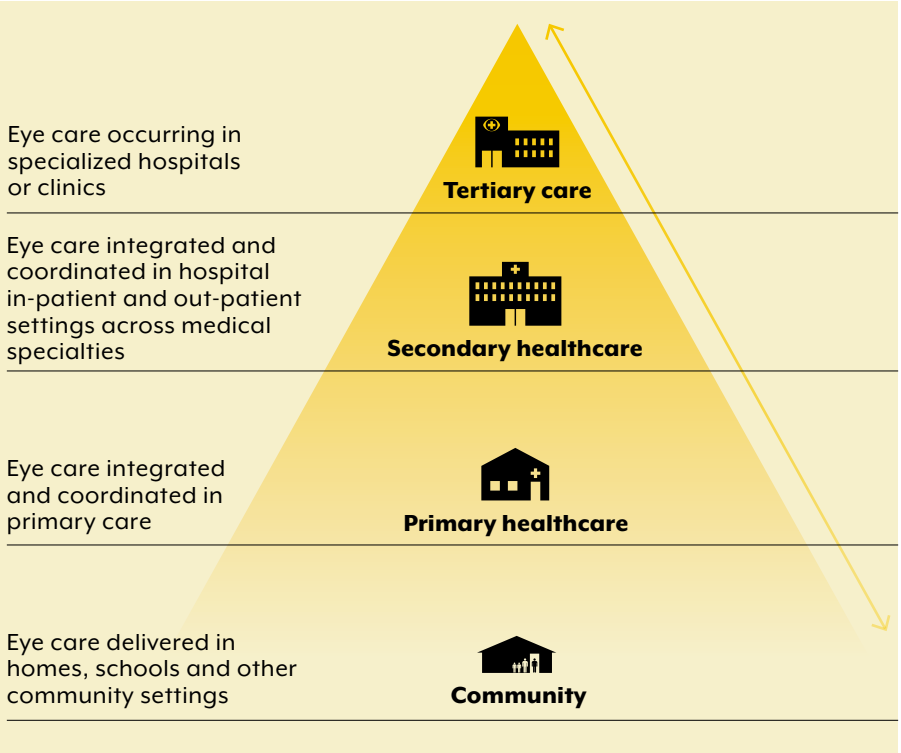
Strengthening eye care in PHC requires adequate funding, appropriate workforce training, a sustainable workforce *(20)*, coordination with other services and sectors, and effectively-planned referral systems. When sufficiently resourced, PHC can meet a large number of people's eye care needs throughout their life course, and can raise awareness of the importance of maintaining eye health and eye disease prevention behaviours, such as facial cleanliness to prevent active trachoma. Services for diabetic retinopathy *(21)*; refractive services for adults; case-finding of common eye conditions, such as cataract; and the diagnosis and management of some common eye conditions that do not typically cause vision impairment, such as conjunctivitis, can also be provided within PHC. In situations where more specialized services are required – for example after the detection of cataracts or diabetic retinopathy – primary care can facilitate referrals and coordination across providers and care settings. Given that many of the eye conditions that can be effectively managed at the primary care level are often conditions for which people seek eye care in secondary and

tertiary eye care settings *(22-26)*, building both a strong primary care and a community delivered eye care can increase the efficiency of eye care services. Of note, building eye care that is integrated into primary care does not place any less importance on secondary and tertiary levels. To address population eye care needs, all levels of care (Fig. 6.1) with integrated and effective referral pathways are needed.

There is no single path countries can follow to achieve a strong primary care that includes eye care. That path may include the integration of primary eye care services within PHC centres, achieved through enhanced supervision and the training of existing staff (Box 6.3), or the adoption of standalone primary eye care services, either in fixed facilities or through mobile units. While technical guidance is not yet available on how to move forward in building a strong primary care specific to the eye care sector, the documents, *A vision for primary health care in the 21st century (20)* and the WHO Technical Series on *Safer Primary Care (27)* offer useful resources.

**There is no single path countries can follow to achieve a strong primary care that includes eye care.**

Figure 6.1 Integrated eye care at all service delivery levels




### Box 6.3 Integration of eye care into primary care through training of existing staff: a case example from Tajikistan

Primary care doctors (*Family doctors*) in Tajikistan undergo a professional training programme based on the national training curriculum. Until recently this curriculum did not include eye and ear care and, as a result, these services were not provided at the primary care level throughout the country. In 2018, with technical and financial support from WHO, a new hearing and vision module was included in the national training curriculum for primary care doctors and nurses. During this period WHO also led awareness raising efforts directly with health workers, to increase acceptance and adherence to the content of the training materials.

At present, forty-eight trainers of primary care doctors and nurses have been trained to educate and demonstrate on how to provide essential ear and eye care. Basic equipment, such as ophthalmoscopes, is also being provided to the trainers (primary care facilities). As a result of these efforts, primary care doctors and nurses within Tajikistan have already identified at least a thousand people with previously undiagnosed ear and eye conditions that require treatment. In 2019, WHO will continue to monitor the results of this intervention; in addition, WHO will fundraise to further strengthen the capacity of eye and ear care at the tertiary level through additional trainings and the provision of sector specific surgical and other diagnostic equipment.

## Coordinating services within and across sectors

**Without good continuity and coordination of eye care, patients are at risk of suboptimal outcomes**

The coordination of services focuses on improving the delivery of care by aligning and harmonizing processes and information; it does not necessarily require merging structures, services, or workflows. The Framework on integrated people-centred health services identifies three strategic approaches: coordinating individuals; coordinating health programmes and providers; and coordinating across sectors. All are fundamental to achieving IPEC.

Coordination of care for the individual involves a range of strategies including case management, team-based care, and efficient referral systems. These strategies contribute to the experience of continuity of care, whereby the process of care is experienced as discrete, coherent and interconnected, and in line with individual needs and preferences. Without good continuity and coordination of eye care, patients are at risk of experiencing fragmented, poorly-integrated care from multiple providers, often with suboptimal outcomes and high levels of dissatisfaction due to failures of communication, inadequate sharing of clinical information and duplication of investigations *(28)*. Crucial to the ongoing success of care coordination is smooth information flow, available to all care providers *(28)*. There are recent examples of the successful implementation of well-coordinated and efficient referral networks in the field of eye care *(29)*.

Coordinating care for the individual presupposes the coordination of all related programmes and providers, and involves bridging information gaps across levels of care as well as ensuring continuity in administration and funding. Additionally, coordinating care may require developing networks of health service delivery at the regional or district levels, integrating existing vertical programmes into the health systems (as described later in Box 6.7), and providing financial and other incentives.

Coordination also encompasses the creation of linkages between eye care and other health programmes, such as neonatal care, noncommunicable diseases, rehabilitation and occupational health and safety. Successful eye care interventions are being delivered through other health services such as retinopathy of prematurity screening through neonatal care *(30)* (Box 6.4).

**Box 6.4 Addressing retinopathy of prematurity in neonatal care: a case study from Argentina**

By the end of the 1990s, retinopathy of prematurity was estimated to be the cause of at least 50% of vision impairment in children *(31)*. In response, the MoH established a multidisciplinary working group to address the problem. Starting in 2004, training was provided to over 70 neonatal care units in preventing, diagnosing and treating the disease. In 2007, national legislation mandated formal integration and continuation of these services, and ongoing funding was subsequently made available through the MoH. An important feature of the changes was the commitment to ongoing collection of data to monitor progress and identify areas for improvement.

Since the programme was established, a 38% reduction has been observed in the number of children with the disease, and a 65% reduction in those who acquired vision impairment as a result *(30)*.

Since health care requires multiple actors, both within and outside of the health sector, coordination of care crosses all sectors, including social services, finance, education, labour, and the private sector. Coordination is primarily a governance and leadership issue, necessitating strong leadership from MoH to coordinate intersectional action. The provision of vision rehabilitation services, for example, requires intersectional partnerships with the social sector so that during the rehabilitation process, the social and labour sectors can offer other support for inclusion and social participation. Coordination with the education sector for the inclusion of programmes for the early identification of eye conditions could also be a solution. To this end, there are a range of guidelines for school based eye care services in different regions and countries. There are also examples of eye care interventions, such as refractive error screening, provided through the education sector *(32)* (Box 6.5).

Given the growing demands for eye care services, effective options for public–private partnerships need to be explored as a means of providing affordable eye care. Examples already exist of such partnerships that have contributed to providing access to eye care services to vulnerable communities, including those for the provision of spectacles (Box 6.6) and interventions for trachoma control in low-resource settings *(39, 40)*.

### Box 6.5 School eye health programme in Baltimore: a case study from the USA

School-based vison screening often provides the first indication of a possible vision impairment or eye condition in children *(33)*. In the United States of America it has been found that many children who fail a screening do not access recommended follow-up care *(34, 35)*. In response, there has been an increased focus on delivering follow-up eye care through schools, particularly in lower socioeconomic neighborhoods *(36-38)*.

In the city of Baltimore, a public–private partnership is underway to deliver school-based eye care to children between the ages of around 4–14 years. The Baltimore City Health Department partnered with Johns Hopkins University Wilmer Eye Institute and School of Education, Baltimore City Public Schools, Vision To Learn and the private sector to create *Vision for Baltimo*re, a city-wide programme providing school-based eye care. Johns Hopkins has been conducting a study alongside the programme to monitor the impact of the intervention on academic performance.

Since the project was first established in 2016, more than 35 000 children in public schools have undergone screening, with approximately 12 000 failing the screening test. Of the 6000 children whose parents permitted a follow-up eye examination, approximately 80% were prescribed spectacles.

Key lessons learnt to date include the importance of building an alliance between health workers and educators to build a school-based model. Partners involved in the project are now exploring ways to increase the number of families that give permission for the eye examination, as well as how to promote the wearing and retention of spectacles.

### Box 6.6 Public–private partnerships for the provision of spectacles in Pakistan, Sri Lanka and South Africa

Public–private partnerships in eye care can be beneficial, especially where provision of public services is weak, under-resourced, or inefficient. Examples from Pakistan, Sri Lanka and South Africa demonstrate the positive outcomes of the collaboration between the MoH and local NGOs or INGOs for the population in need of refractive services and spectacle provision.

In Pakistan, for example, the Layton Rahmatulla Benevolent Trust (LRBT) Hospital, the largest NGO and eye care provider in the country – in collaboration with the Government of Pakistan and the Brien Holden Vision Institute – is currently establishing optical stores in secondary and tertiary hospitals. Optical stores are embedded in the LRBT hospital system. When patients are prescribed spectacles by optometrists or ophthalmologists, they can purchase them from the optical stores located next to the hospital pharmacies. Since October 2016, LRBT has provided spectacles to 18 619 individuals, of whom 68% are women and girls, mostly from low- to middle-income communities.

In Sri Lanka, The Brien Holden Vision Institute, in partnership with Ministry of Health & Nutrition, established four vision centres and optical shops to provide refractive and optical services to semi-urban and rural communities. Vision centres have been established in communities where public eye care facilities were not available and work in close coordination with the health department. Patients who need surgical services or are diagnosed with complex eye health anomalies are referred to secondary and tertiary eye care facilities in public or private sectors. To date, 94 782 people (57% women and girls) have been provided with spectacles by optometrists at the vision centres.

In the KwaZulu-Natal and Gauteng provinces of South Africa, The Brien Holden Vision Institute, has been providing a spectacle delivery service in collaboration with Department of Health since 2007. Since the start of the collaboration, over 165 000 spectacles have been dispensed, 26 000 of them at no cost.

Besides the provision of spectacles to those in need, these partnerships have also contributed to the increased awareness of the need for marginalized communities to have access to eye care and for local management and monitoring support for the optical services.

However, several challenges remain in spectacle supply in these countries. Availability of qualified and skilled human resources (optometrists and optical technicians) is a significant challenge, as there is no standard training programme available in many countries. The sector remains unregulated, and local legislation and relevant authorities are insufficient. The informal sector has contributed to the growth of optical street vendors, and online eyewear sellers place pressure on the smaller optical chains and independent vision centres/optical shops.

**The first step is the integration of eye care into health system planning**

The three previous strategies described, will only become operational if enabling environments are in place. WHO has conceptualized an enabling environment as six building blocks of a health system. Of these six blocks, one – the delivery of eye care services – is the focus of IPEC. Although the remaining five – leadership and governance; information; health workforce; health financing; and medicines and health technologies (including assistive products) are all relevant to realizing IPEC, given the specific challenges faced by the eye care sector outlined in Chapter 4, this section will elaborate on leadership and governance, health workforce and information only.

### Leadership and governance

Good governance involves transparent leadership that is inclusive, participatory and makes the best use of available resources and information to ensure the best possible results. It is sustained by mutual accountability among those who make and implement policy, managers, providers and the users themselves. The responsibilities of governance in health care involves developing a strategic plan, then managing accountability and overseeing the plan's implementation. In most countries, the strategic plan is a national health plan that sets out the core values of the health system; the health outcome targets to be achieved; a concrete action plan for achieving these targets; and a time frame for doing so. In order to carry out strategic planning, leadership is needed to create a coalition of stakeholders – across sectors of government and civil society – to collect information on inputs, service access, coverage and health outcomes, and to create regulations and formal standards of practice *(41)*.

The importance of strategic planning in the health sector cannot be overstated. Unfortunately, as discussed in Chapter 4, for most countries, eye care is often omitted in national health strategic plans, or only briefly mentioned *(42)*. To realize IPEC in countries, however, the inclusion of eye care in national health strategic plans is of utmost importance for ensuring that issues of eye care service provision are systematically addressed and fully integrated. The first step is the integration of eye care into health system planning, in terms of overall targets and a concrete plan of how to achieve these targets. Secondly, at an operational level, integration will contribute to eye care interventions being included across all service delivery platforms and other health areas. Finally, integration increases the likelihood of eye care being

considered within broader human resources, assistive products and health technology procurement and infrastructure plans.

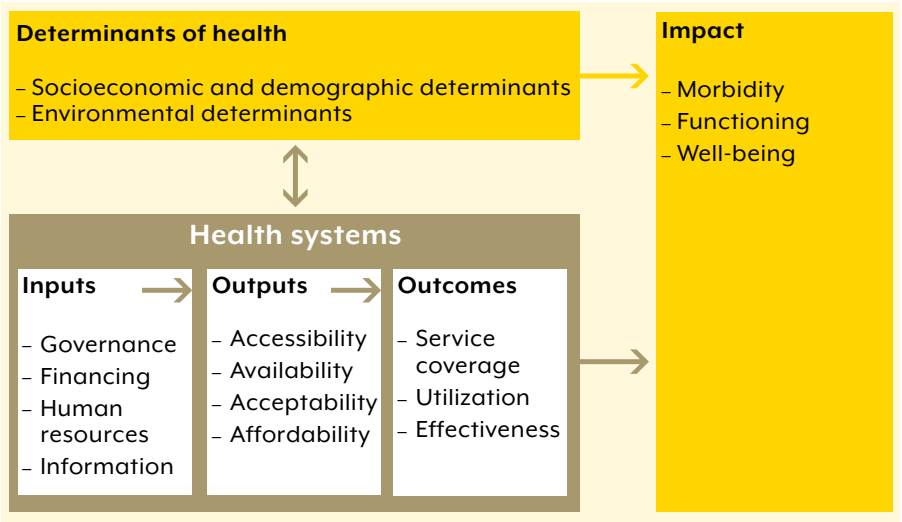
Even in situations where a health system is not the main provider or financer of specific eye care services, the role of governance will remain important. Regulatory frameworks for the engagement of state, private and non-state actors in the eye care sector need to be in place to reduce risking the development and sustainability of equitable eye care services. When a strong regulatory framework exists and is enforced, privatization, commercialization and marketization have the potential to increase universal access to eye care services. Market forces alone, however, will not automatically lead to equitable and universal access. For this reason, equitable access to eye care must remain a constant goal and supported by a strong regulatory framework *(43)*.

## Information

Key components of the information building block include the development of a health information and surveillance system; the use of standardized tools and instruments; and the collation and publication of national and international health statistics. These components make possible the generation and strategic use of information and research on health and health systems.

A well-functioning HIS ensures the production, analysis, dissemination and use of reliable and timely health information by health policy, management and clinical decision-makers on a regular basis. As presented in Fig. 6.2, a HIS covers three domains: health determinants; health systems capacity and performance (inputs, outputs and outcomes); and health status (impact). To collect information from these three domains, a HIS must generate population and facility-based data from censuses, civil registration data, population surveys, individual records, and service and resource records by means of standardized tools and instruments. The system also needs to have the capacity to synthesize information in the form of sensitive, valid and reliable indicators and the ability to promote the knowledge that arises from those indicators. An example of a development of a well-integrated HIS in the field of eye care is described in Box 6.7.

Fig. 6.2 Domains of measurement of health information systems




*Adapted from:* Framework and standards for country health information systems, second edition. Geneva: World Health Organization, 2012.

### Box 6.7 Integrating vertical programmes into the health system and development of well-integrated health information system: a case study from Oman

In the 1970s, active trachoma was endemic in Oman with an estimated prevalence of 70–80% among the Omani population of all ages. To address this public health issue, the MoH of Oman, with assistance from WHO, started a vertical "trachoma control programme" with a focus on the treatment of trachoma in schools. The programme resulted in a substantial decline in the incidence of the disease to 7% by 1983. Due to its success, the MoH expanded the programme and included two additional vertical components, namely the screening of school children, and community screening in endemic regions.

In 1991, the programme was further expanded, renamed the "Eye health care programme" and was integrated into the national health care plan of Oman, focusing on six priority eye conditions: cataract, trachoma, glaucoma, corneal diseases, diabetic retinopathy and refractive error. A national eye care committee was established to plan the implementation and evaluation of activities relating to eye care in Oman. Eye care services were provided through school health services and the MoH PHC institutions to provide comprehensive eye care.

At the end of the 1990s, the national health care plan prioritized eye care under the "specific disease control programmes" targeting certain priority health problems. All health-care providers were trained in the prevention and management of eye conditions, as well as the recording and evaluating of eye care activities. Eye care services were expanded to cover all service levels of the health system, including community, primary, secondary and tertiary levels. In 2014, a national eye strategy with an action plan for 2016–2020 was developed by the MoH in collaboration with WHO and the Eastern Mediterranean Regional office of the International Agency for the Prevention of Blindness in accordance with the WHO Global Action Plan 2014–2019 towards universal eye health.

The centralized HIS is an important part of the eye care services in Oman. Oman initially started an "Eye health care monthly reporting system" in all health institutions under the MoH and the school eye care. The aim was to collect monthly data on all vision screenings of preschool-aged children at primary health care institutions, as well as referrals to secondary or tertiary level institutions, and statistical data on the eye care of both outpatients and inpatients from secondary and tertiary centres. As an example, primary eye care institutions would report new cases of cataract, whereas secondary and tertiary institutions with ophthalmic units would collect information on, and report monthly, all new cataract cases – which were linked with visual status and ICD 10 codes – and all cataract cases managed. With regards refractive error, secondary and tertiary centres would report all new cases as per the ICD codes, whereas cases of refractive error detected at school screenings would be recorded and reported to the regional school refractionist as early as possible so that further prompt action could be taken.

In 2008, a National Electronic Health Information Management System (the Al Shifa 3+ system) was launched in Oman. Al-Shifa is being used across all levels of health-care units with the MoH acting as the reporting body. The system was designed to meet the needs of all levels of management, including data capturing and entering and the delivery of essential information needed by the middle management for the day-to-day operations of the health-care facility. The system also acts as a data warehousing and business intelligence suite which provides national level health-care statistics on key performance indicators on different eye conditions (e.g. cataract, refractive error, childhood blindness, diabetic retinopathy, etc.) accumulated from all facilities. These statistics enable the central level administration to analyse the overall functioning of health-care centres across the sultanate, and prepare the national annual report which serves to address gaps in the eye care programme, plan future activities, and strengthen the eye care programme.

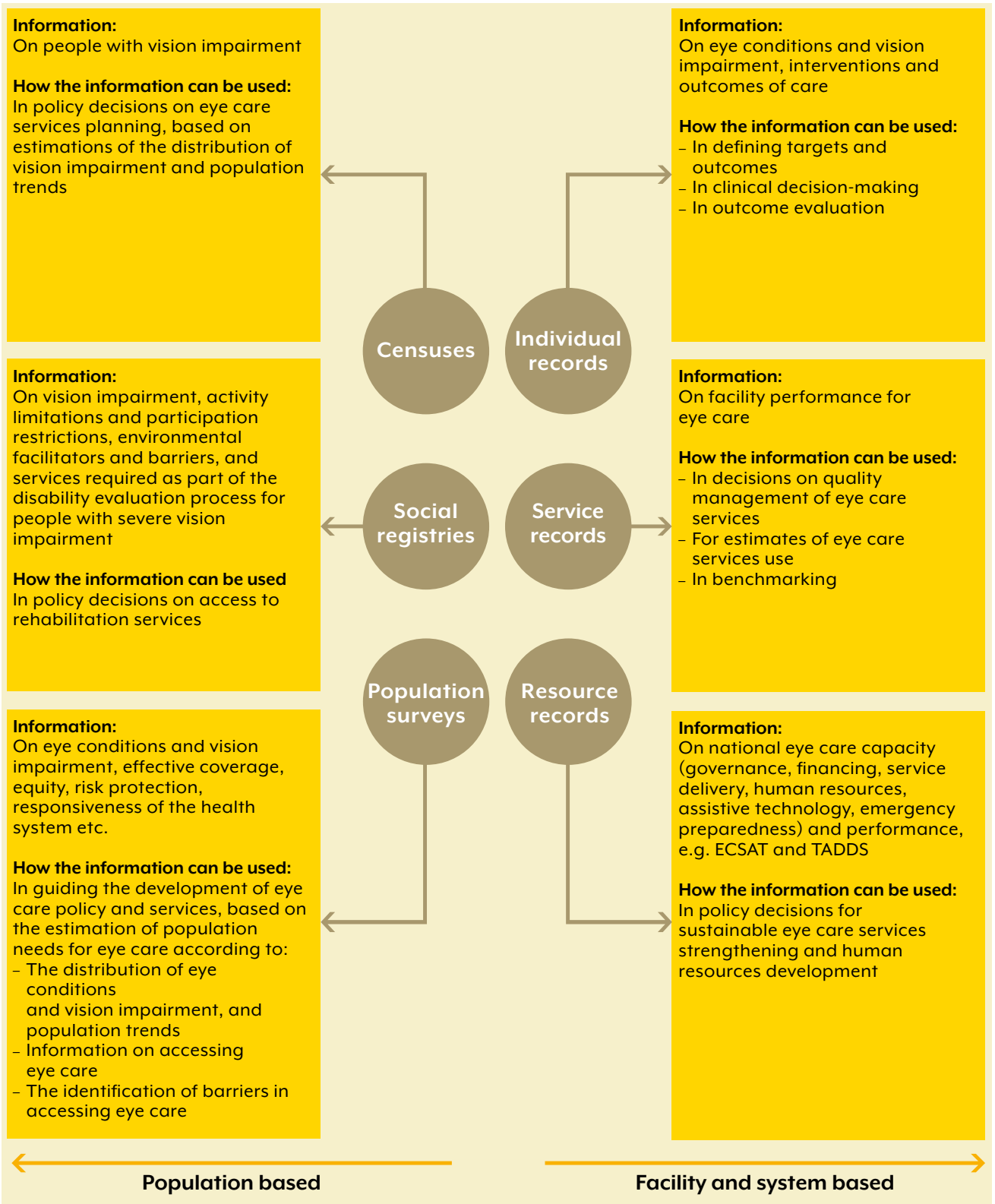
In addition to the data collected from the health information management system, Oman uses other sources of information on eye conditions and vision impairment. These include national population-based surveys, such as the National Blindness Survey and National Glaucoma Survey, MoH annual statistical reports, and various national studies on eye care.

*Implications*

Since the introduction of the eye care services in Oman, the prevalence of trachoma among the Omani population has declined from almost 80% in 1970s, to a level where, in 2012, Oman became the first country to be internationally certified as trachoma free. In addition, the rate of blindness among those aged 40 years and older declined by approximately 30% between 1996 and 2010. There has been a marked increase in the number of ophthalmologists in the country, and eye units are now provided with modern technology and computerized case record systems. Through strengthening the referral system, especially at the primary care level, all patients with diabetes are now referred to ophthalmic units for screening for diabetic retinopathy. The eye care programme at primary, secondary and tertiary care units have been strengthened by analysing the institutional, as well as regional, reports on eye care activity through the health information management system.

Applied to eye care, and with the objective of moving towards IPEC, a HIS should collect information about i) the determinants of eye conditions; ii) the capacity of the health system to provide eye care services as well as its performance, and in particular, how well existing eye services address population needs in an equitable manner; and iii) the numbers of individuals with eye conditions and vision impairment, and their level of functioning and well-being. As illustrated in Fig. 6.3, to achieve these goals, tools and instruments need to be in place to collect population, facility and system-based data. These data generate information about eye care, as well as facilitating research on eye conditions and vision impairment, including research on health systems and eye care. Fig. 6.3 also shows the information generated by each of the sources and how the information can be used.

Figure 6.3 Data sources and information for decision-making and strengthening eye care




*Adapted from:* Framework and standards for country health information systems, second edition. Geneva: World Health Organization, 2012.

As discussed in Chapter 4, the eye care sector can build on its many successes, including the frequent implementation of population-based surveys to generate prevalence estimates of certain eye conditions and vision impairment and the use of standardized tools, such as ECSAT and tool for assessment of diabetes and diabetic retinopathy (TADDS). Nevertheless, as discussed earlier, the eye care sector needs to ensure that the data generated in population surveys will support eye care service planning and provide information on the numbers of people of all ages with vision impairment whose needs have been met, as well as those whose needs have not yet been met. This ensures that comparable information is collected and reported on important service coverage indicators.

**The eye care sector needs to ensure that surveys will provide information on the numbers of people of all ages with vision impairment whose needs have been met, as well as those whose needs have not yet been met.**

Monitoring the implementation of IPEC also requires strategic, systematic planning to identify which information should be generated from what data sources (population-, facility- or system-based). Relevant indicators need to be developed. The eye care sector will only be able to report on interventions covering health promotion, prevention, treatment and rehabilitation; population needs; coordination of services; and the perspectives of eye care users, when comprehensive population-based facility and systems based data are collected. Information from these sources is required for the realization of IPEC.

### Workforce

The realization of IPEC largely depends on the availability, accessibility, acceptability and quality of a health workforce and the services they provide. As outlined in Chapter 2, there are, however, human resource challenges that include general shortages, maldistribution of workers, attrition, imbalances in skill composition and, at times, inadequate regulation *(44-48)*.

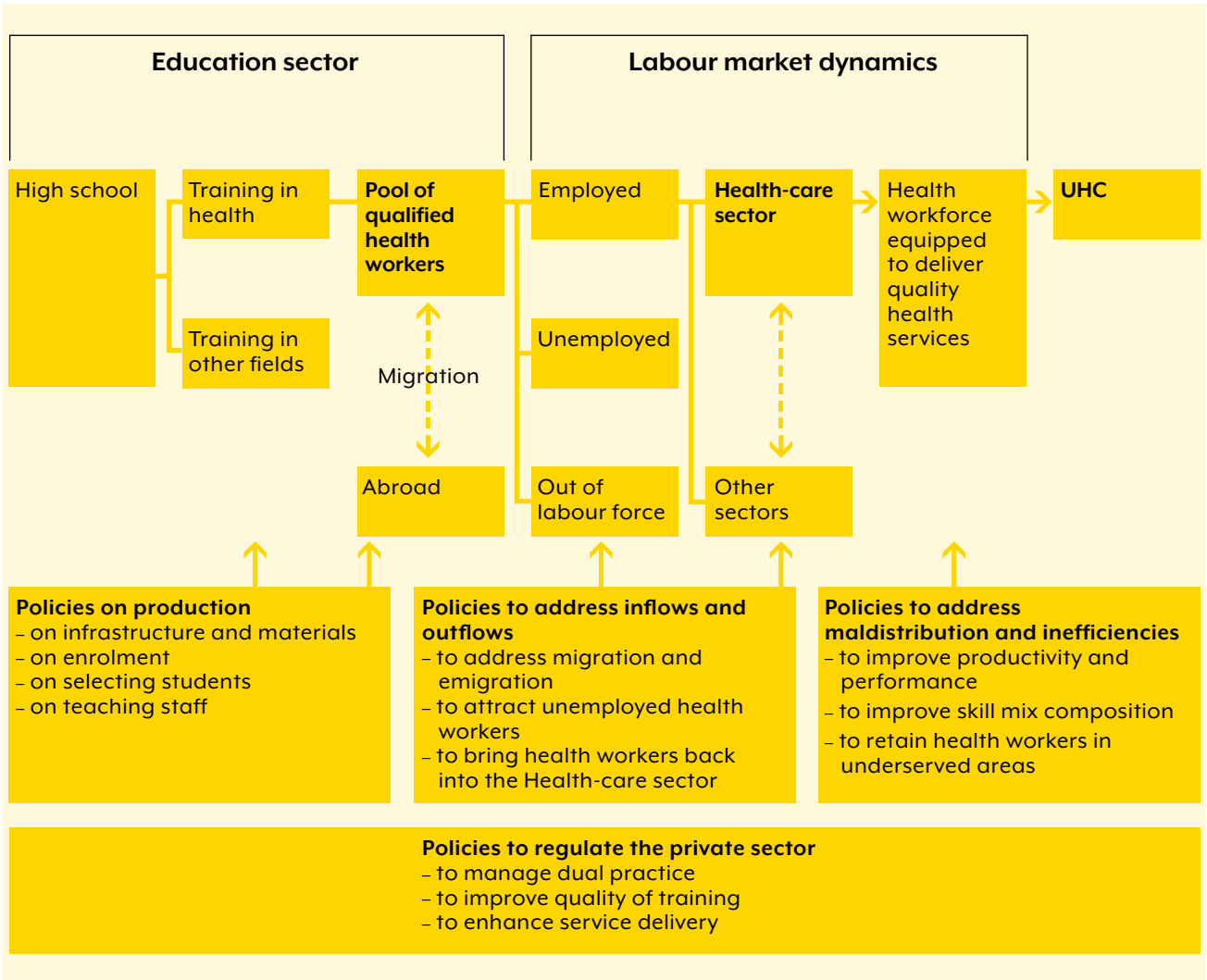
Until recently, the number of eye care workers per million population has been used as a guide in workforce planning. While this approach is relatively simple, it does not consider other determining factors, such as population structure, epidemiology, regulations and standards, the location of the current workforce and public demand *(49)*. It assumes that eye care is delivered by a pre-defined set of health workers only, such as ophthalmologists, optometrists or opticians, while in reality, eye care is delivered by multiple specialized and non-specialized actors, particularly at primary level. To address the challenges described in Chapter 4, and to realize IPEC in the context of UHC, the eye care sector, starting with professional organizations, will need to work closely with relevant policy-makers in countries responsible for developing policies to optimize the supply of health workers. IPEC will require comprehensive planning of the eye care workforce, inclusive of all health workers involved at the entry point of health care (primary care) and based on an in-depth analysis of the health labour market in

general. The challenges of the health labour market are diverse, extending beyond the basic question of the density of health workers involved in eye care, to include, for example, inequity in the distribution of health workers, migration, and retention of workers. Some challenges are associated with policies and governance on health workforce; others, such as quality, availability and data use, relate to HIS. To tackle these challenges, WHO developed the global strategy for human resources for health: workforce 2030 *(50)*.

**IPEC depends on the availability, accessibility, acceptability and quality of a health workforce and the services they provide.**

The health labour market Framework presented in Fig. 6.4 provides an overview of the main forces influencing the dynamics of the health labour market that would impact on equitable access to quality health services and UHC *(49)*. Driving forces comprise multiple sectors, including those of education and labour. The education sector needs to ensure that sufficient health workers are trained with appropriate knowledge and skills; the labour sector needs to ensure that working in the areas of health is attractive, and that financial incentives and working conditions assure an appropriate distribution of health workers. Policies on education and labour strongly influence these factors. Realizing these factors requires the coordination of a broad range of stakeholders; MoH, education, public service, and economy and finance, and professional organizations will work together to guarantee the availability of health workers involved in eye care.

Figure 6.4 Health labour market framework and policy levers for achieving universal health coverage *(51)*




*Adapted from:* Framework and standards for country health information systems, second edition. Geneva: World Health Organization, 2012.

**Countries need comprehensive assessments on the availability of health workers with skills in eye care.**

To better understand the challenges facing the eye care health workforce, countries need comprehensive assessments on the availability of health workers with skills in eye care which requires investment in HIS. At the WHA in May 2016, and as part of the global strategy on human resources for health, Member States were urged to progressively implement the National Health Workforce Accounts (NHWA) *(52)*. WHO has developed overall guidance and a series of NHWA tools to improve, over time, the availability, quality and use of data through monitoring standardized indicators on health workforce. With improved data through NHWA, health labour market analysis can be conducted, and can facilitate the understanding of eye care workforce dynamics which involves the assessment of the supply and demand of health workers involved in eye care.

In general terms, the supply – i.e. the number of qualified health workers willing to work for the eye care sector – is determined by wages, working conditions, safety conditions and career opportunities. The demand for health workers is determined by the needs of the population and the demand for eye care services. There are, however, many dynamic factors that need to be considered when planning the eye care workforce. For instance, supply depends on the extent to which the private and public institutions are willing and able to pay for health workers involved in eye care to be employed in primary care centres, clinics, hospitals or other parts of the health system. Institutions also compete with each other on wage rates, budgets, provider payment practices, labour regulations and hiring rules. The eye care sector similarly competes with other health areas in attracting health workers.

**It is vital to ensure that the eye care sector orients eye care workforce planning towards the primary care setting.**

Health systems involved in eye care cannot deliver adequate services without addressing the role of the private sector in all aspects of workforce planning, from education to the labour market. These policies include regulations on staff training, service quality and dual practice, to ensure equitable access to quality health services for the entire population. Although, in many countries, it is difficult to determine the exact proportion of eye care delivered in the private sector, and of health workers engaged in dual practice, both are known to be high. However, there is little evidence as to whether this has positive or negative consequences for the availability of health workers involved in eye care or the quality of services. This lack of evidence should stimulate not only the development of policies specifically designed to regulate the private sector, but also health policy and system research in the field of workforce in the eye care sector.

When implementing IPEC, it is vital to ensure that the eye care sector orients eye care workforce planning towards the primary care setting. This not only requires ensuring that primary care personnel have the competencies required to provide eye care interventions – particularly those for early identification and referral to specialized eye care when

required – but also for the development of policies to facilitate the coordination of health workers providing services at primary care level.

Realizing IPEC also requires a competency-based care approach to workforce planning. Competencies refer to the specific tasks an individual must be able to perform to a specified standard to qualify as a professional. Competences are needed for different interventions, and health workers with appropriate competences and skills will be required at each service delivery level. There are already examples where the eye care sector is moving towards competency-based planning approaches (Box 6.8). The WHO Regional Office for Africa has recently developed core competencies for the eye care workforce in the African Region to improve the distribution of skills in the eye team *(53)*.

**Box 6.8 Competency-based eye care: an example from Fiji and Papua New Guinea**

Small island developing states can find it challenging to develop and maintain cadres of specialist health-care workers. In the Pacific, The Fred Hollows Foundation, New Zealand developed a training programme to build eye care competencies for nurses and doctors.

The Pacific Eye Institute (PEI) was established in 2006 offering a Post-Graduate Diploma in Eye Care for nurses, and a Master of Medicine in Ophthalmology for doctors. The diploma for nurses has been specifically designed to ensure nurses have the competencies to respond to population eye care needs in the region, such as refraction and health promotion. In recognition of the increasing prevalence of diabetes in the region, a competency on screening, grading of images for diabetic retinopathy and referrals has recently been added to the curriculum.

The diploma is now offered in Fiji and Papua New Guinea, and around 150 nurses from 11 countries have completed the qualification, which is recognized by many governments in the region.

Innovative workforce approaches, such as shifting activities between health workers through role delegation, will be needed to address inefficiencies and enhance equity in the eye care service delivery *(54)*. Role delegation has the potential to expand the number of mid-level health-care workers that can safely provide clinical tasks, or key components of tasks, that would otherwise be restricted to higher level cadres such as ophthalmologists. Such a shift would require action on the continuous professional education and on educational accreditation mechanisms. If policies allowing the effective use of defined skills and competencies of the health workforce are enforced, a more rational distribution of tasks and responsibilities among health workers involved in eye care can be created to improve access and cost-effectiveness *(46)*. Some countries have already enabled mid-level health workers to deliver a range of eye care services, using these cadres, either alone, or as part of teams within communities and health care facilities at different levels of the health system *(55)*.

Finally, strengthening eye care delivery according to population needs through a strengthened eye care workforce can yield dual positive economic benefits: (i) it reduces the impact of eye conditions and vision impairment on populations and, thus, productivity can be increased; and (ii) it creates jobs, directly and indirectly, in the health workforce with skills to address eye care needs. The UN High-Level Commission on Health Employment and Economic Growth reported in 2016 that the health sector is one of the sectors with highest potential to economic growth *(56)*. Health workforce financing should therefore be seen as an investment and not as a cost.

Putting into effect IPEC and securing UHC will not be possible unless the inefficiencies of the eye care workforce are eliminated, adequate funding secured, and the productivity and performance of health workers improved. Health workforce policies are needed to address worker shortages and maldistribution. Such policies need to be tailored to individual country context and population eye care needs.

To achieve the goal of integrating eye care into UHC, the *World report on vision* proposes the adoption of IPEC – the integrated, people-centred approach to eye care service delivery. IPEC has the potential to address many of the key challenges to the effective delivery of eye care services described in the report: services that are fragmented, of unequal quality, and not effectively provided at the primary care level; an uncoordinated and, at times, unregulated workforce that leads to shortages and maldistribution; and poor integration of eye care information into HIS. IPEC promotes equity in the provision of services according to population needs, and is therefore crucial to progress in achieving the targets of the SDGs and UHC. Chapter 6 reviews the four strategies for achieving IPEC: empowering and engaging people and communities; reorienting the model of care towards primary care; coordinating services within and across sectors; and creating an enabling environment through enhanced governance and leadership, a sufficient and well-trained workforce, and improved HIS.


BOBES

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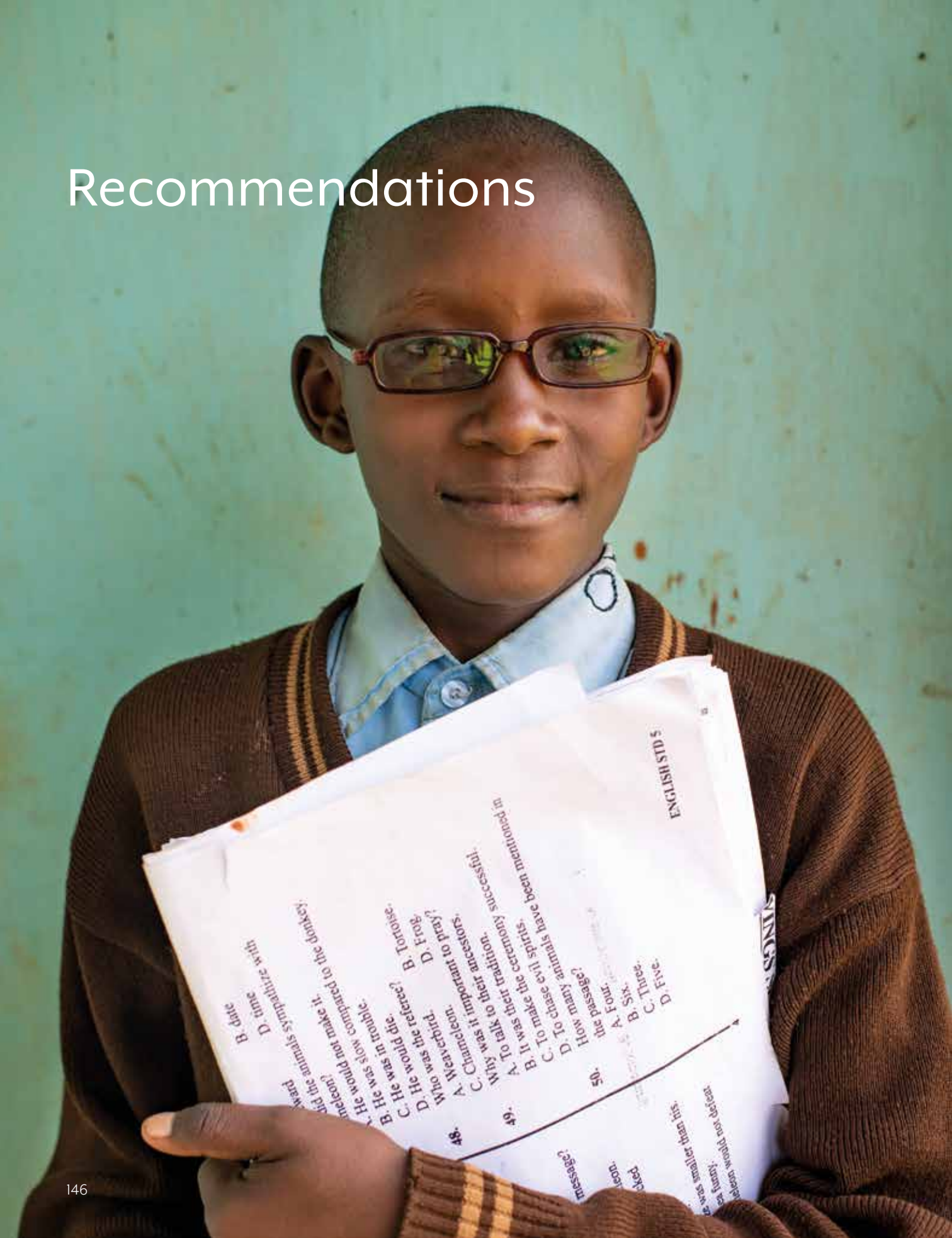
# Recommendations



# Making IPEC a reality

Globally, at least 2.2 billion people have a vision impairment, of whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed. Population ageing, coupled with lifestyle changes, is leading to a dramatic increase in the number of people with eye conditions and vision impairment. In addition to urgently addressing this increasing coverage gap, health systems must sustain care for those whose needs are already being met. The extent of these met and unmet needs is currently unknown. However, sufficient evidence is available to act now; every country can take action, irrespective of the maturity of their health system or level of development.

Fortunately, eye care is an area of health care with highly cost-effective interventions for health promotion, prevention, treatment and rehabilitation to address the full range of needs associated with eye conditions and vision impairment across the life course. The benefits for the individual and society are significant. Addressing eye care needs also contributes intrinsically to progress towards UHC and the SDGs.

The *World report on vision* shows the substantial progress made during the past 30 years, thanks to concerted global advocacy and actions. Nevertheless, unmet needs remain: inequalities in coverage exist, and ensuring quality is a challenge. In the report, IPEC is proposed as an approach that ensures the delivery of eye care in adherence to universal health coverage.

To realize integrated people-centred eye care, each country or region needs to assess its current situation and context before mapping out specific next steps. Five global priority areas and recommended actions are identified:

## 1. Make eye care an integral part of universal health coverage

In order to eliminate inequalities in access to, and provision of, eye care services across the population, it is essential to plan these services carefully and according to the best available information about population needs, while ensuring quality. Until recently, the eye care sector has concentrated on reporting unmet needs. Effective planning of quality eye care services as part of UHC also requires information about ongoing and met needs and ensuring that the cost of priority eye care interventions does not expose the user to catastrophic expenditures.

*Recommended actions are:*

- Collecting and reporting information on the met and unmet eye care needs of the national population.
- Developing a package of eye care interventions to respond to population needs for strategic inclusion into the budgeting of UHC.
- Improving access with financial risk protection for priority eye care interventions, especially for low-income groups and other disadvantaged groups.
- Defining the desired outcomes of eye care interventions, for quality assurance, and reporting effective coverage.
- Defining input, output and outcome indicators to monitor the quality of eye care at the national level, and to make comparisons across countries.
- Ensuring that individuals with vision impairment or blindness that cannot be treated have access to high-quality vision rehabilitation to optimize functioning.

## 2. Implement IPEC in health systems

IPEC has the potential to overcome the challenges facing countries in providing access to priority eye care services – such as shortages of trained workforce, fragmented services and, at times, suboptimal quality outcomes – and in ensuring equitable access for all people. A health systems perspective is required, and recognition of the necessity to integrate services and respond to people's needs and preferences.

*Recommended actions are:*

- Integrating eye care into national health strategic plans.
- Strengthening eye care in PHC to improve access, and to adapt and respond to rapidly changing population needs, including the projected growth in the number of people with noncommunicable eye conditions.
- Increasing effective coverage of refractive error and effective coverage of cataract surgery – the leading causes of addressable vision impairment and blindness.
- 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.
- Reinforcing the coordination of eye care services in relevant programmes (e.g. diabetes, maternal child health, ageing); and sectors (e.g. social, education and labour).
- Ensuring that eye care workforce planning is an integral part of health workforce planning.
- Ensuring that health information systems include comprehensive information about eye care to identify needs; to effectively plan service delivery; and to monitor progress towards implementing IPEC and its impact at the population level.

## 3. Promote high-quality research

To sustain implementation of IPEC, high-quality implementation and health systems research is required, thus complementing existing evidence for effective eye care interventions. Moreover, studies analysing the costs and benefits of implementing the package of eye care interventions at the individual and societal level will be necessary. Eye care has a high potential of benefiting from technological advances; research is required to ensure such advances impact on clinical care and people's lives.

*Recommended actions are:*

- Supporting the creation of a global research agenda that includes health systems and policy research, and technological innovation for eye care that facilitate the development of a national research agenda.
- Promoting collaboration between researchers and ministries of health to ensure research is relevant to the national setting and to the implementation of IPEC.
- Creating or enhancing existing funding schemes for implementation and health systems research for eye care.
- Promoting return on investment studies to provide evidence on how investing in eye care secures health, social and economic return.
- Strengthening implementation research for scaling-up technological advances and task-sharing to ensure they rapidly benefit people with eye conditions and vision impairment.
- Encouraging governmental and private foundations in their support of research on innovative treatments and diagnostics both to eliminate blindness from eye conditions, and to eliminate eye conditions.

## 4. Monitor trends and evaluate progress

It is important to monitor the progress made towards implementing IPEC and its impact at the population level. This requires comprehensive information from health information systems on eye care and epidemiological data on eye conditions and vision impairment. Indicators and benchmarking are also required to evaluate progress toward implementation.

*Recommended actions are:*

- Strengthening national capacity to collect, analyse and use data on the burden and trends of eye conditions and vision impairment.
- Conducting periodic population surveys that include measurement of vision impairment, as defined in this report, and integrate variables relevant to eye care in general health surveys, ensuring that effective coverage of cataract surgery and refractive errors can be reported.
- Supporting the creation of a global indicators menu for eye conditions and vision impairment that facilitates the selection of national indicators and promotes cross-country comparisons.
- Defining how to, and periodically conducting, evaluations of the progress made towards implementation of IPEC.

## 5. Raise awareness and engage and empower people and communities

The public and individual communities – specifically underserved populations, such as women, migrants, indigenous peoples, and persons with certain kinds of disability – need to be made aware of the importance of early identification of eye conditions; the need to prevent and address vision impairment; and how they can be empowered to gain access to eye care services.

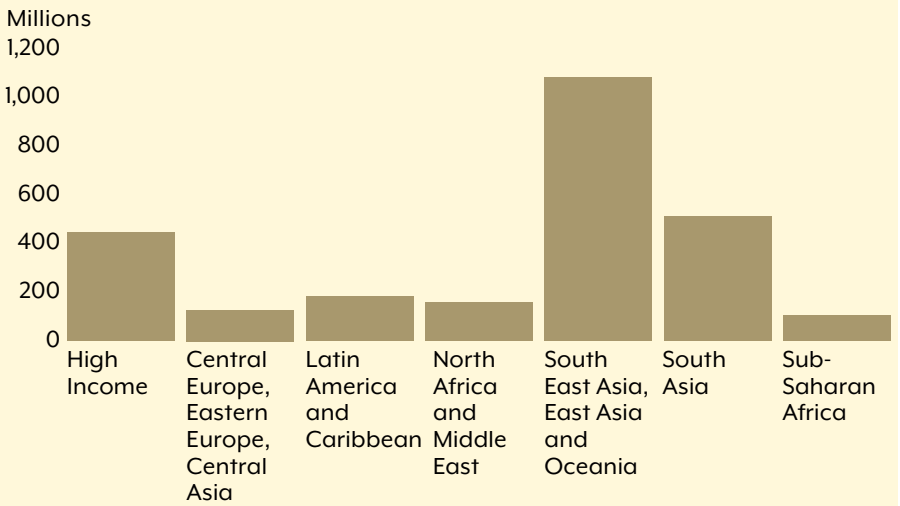
*Recommended actions are:*

- Raising awareness about the availability of effective interventions that address all eye care needs across the life course.
- Conducting public health campaigns that emphasize the importance of eye care.
- Engaging and empowering the public, specifically underserved populations, to be aware of their eye care needs and demand and seek eye care services.
- Engaging the education and labour sectors as partners in raising awareness about the importance of identifying eye conditions and accessing eye care services among students and employees.
- Raising awareness of the societal obligation to fulfil the rights of individuals with vision impairment and blindness that cannot be treated, to participate in society on an equal basis with others.

# Annexes

## Annex I: Regional comparisons of the numbers of people with selected eye conditions

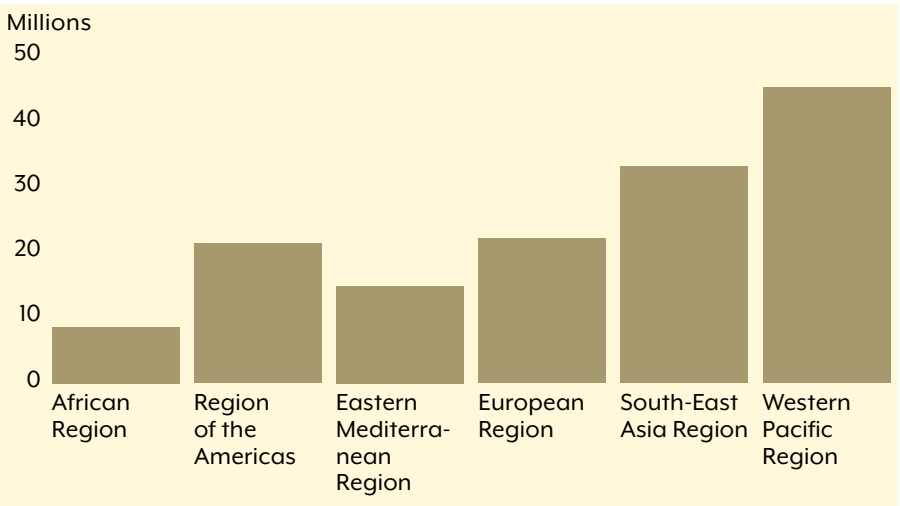
Fig. A1.1 Regional comparison of the total number of people with myopia*




* By Global Burden of Disease regions

*Adapted from:* Holden BA, Fricke TR, Wilson DA, Jong M, Naidoo KS, Sankaridurg P, et al. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. Ophthalmology. 2016;123(5):1036–42.

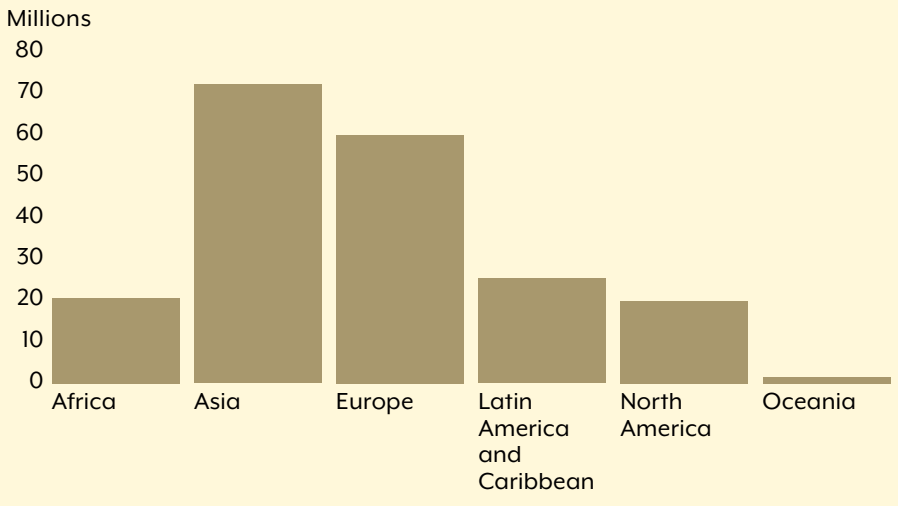
Fig. A1.2 Regional comparison of the total number of people with diabetic retinopathy*




* By WHO regions

*Adapted from:* World Health Organization. Global report on diabetes. 2016 and Yau J, Rogers S, Kawasaki R, Lamoureux E, Kowalski J, Bek T, et al. Global prevalence and major risk factors of diabetic retinopathy. Diabetes Care. 2012;35:556-64.

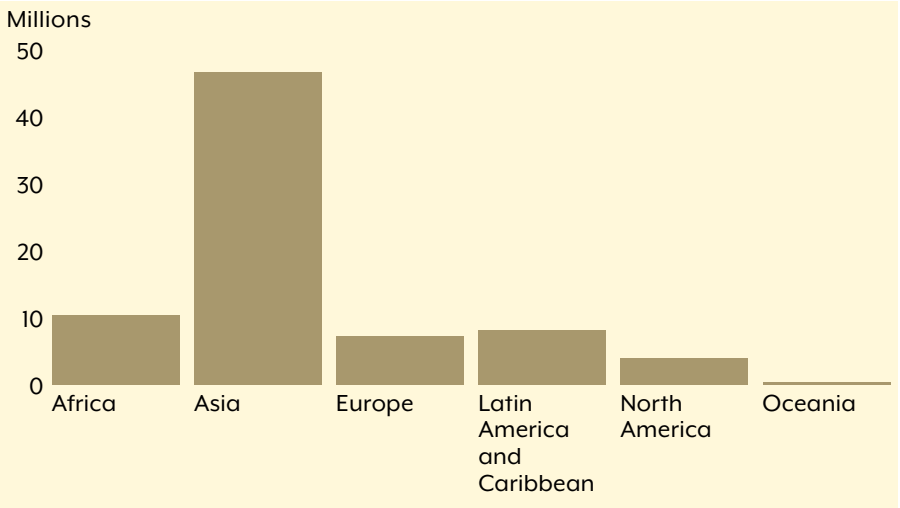
## Fig. A1.3 Regional comparison of the total number of people with age-related macular degeneration*




* By United Nations' classification of macro-geographic continental regions

*Adapted from:* Wong WL, Su X, Li X, Cheung CM, Klein R, Cheng CY, et al. Global prevalence of age-related macular degeneration and disease burden projection for 2020 and 2040: a systematic review and meta-analysis. The Lancet Global Health. 2014;2(2):e106–16

## Fig. A1.4 Regional comparison of the total number of people with glaucoma*




* By United Nations' classification of macro-geographic continental regions

*Adapted from:* Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. Ophthalmology. 2014;121(11):2081–90

## Annex II:
## List of countries included in the regional comparisons of selected eye conditions and vision impairment presented in Chapter 2 and Annex 1 of this report

### 1. Distribution of glaucoma and age-related macular degeneration (United Nations' classification of macro-geographic continental regions)

*Asia*

Afghanistan; Armenia; Azerbaijan; Bahrain; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; China, Hong Kong Special Administrative Region; China, Macao Special Administrative Region; Cyprus; Democratic People's Republic of Korea; Georgia; India; Indonesia; Iran (Islamic Republic of); Iraq; Israel; Japan; Jordan; Kazakhstan; Kyrgyzstan; Kuwait; Lao People's Democratic Republic; Lebanon; Malaysia; Maldives; Mongolia; Myanmar; Nepal; Oman; Pakistan; Philippines; Qatar; Republic of Korea; Saudi Arabia; Singapore; Sri Lanka; State of Palestine; Syrian Arab Republic; Tajikistan; Thailand; Timor-Leste; Turkey; Turkmenistan; United Arab Emirates; Uzbekistan; Viet Nam; Yemen.

*Africa*

Algeria; Angola; Benin; Botswana; British Indian Ocean Territory; Burkina Faso; Burundi; Cabo Verde; Cameroon; Central African Republic; Chad; Comoros; Congo; Côte d'Ivoire; Democratic Republic of the Congo; Djibouti; Egypt; Equatorial Guinea; Eritrea; Eswatini; Ethiopia; French Southern Territories; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Kenya; Lesotho; Liberia; Libya; Madagascar; Malawi; Mali; Mauritania; Mauritius; Mayotte; Morocco; Mozambique; Namibia; Niger; Nigeria; Réunion; Rwanda; Saint Helena; Sao Tome and Principe; Senegal; Seychelles; Sierra Leone; Somalia; South Africa; South Sudan; Sudan; Togo; Tunisia; Uganda; United Republic of Tanzania; Western Sahara; Zambia; Zimbabwe.

*Europe*

Åland Islands; Albania; Andorra; Austria; Belarus; Belgium; Bosnia and Herzegovina; Bulgaria; Croatia; Czechia; Denmark; Estonia; Faroe Islands; Finland; France; Germany; Gibraltar; Guernsey; Greece; Hungary; Holy See; Iceland; Ireland; Isle of Man; Italy; Jersey; Latvia; Liechtenstein; Lithuania; Luxembourg; Malta; Monaco; Montenegro; Netherlands; North Macedonia; Norway; Poland; Portugal; Republic of Moldova; Romania; Russian Federation; San Marino; Sark; Serbia; Slovakia; Slovenia; Spain; Svalbard and Jan Mayen Islands; Sweden; Switzerland; Ukraine; United Kingdom of Great Britain and Northern Ireland.

*Oceania*

American Samoa; Australia; Christmas Island; Cocos (Keeling) Islands; Cook Islands; Fiji; French Polynesia; Guam; Heard Island and McDonald Islands; Kiribati, Marshall Islands; Micronesia (Federated States of); Nauru; New Caledonia; New Zealand; Niue; Norfolk Island; Papua New

Guinea; Solomon Islands; Northern Mariana Islands; Palau; Pitcairn; Samoa; Tokelau; Tonga; Tuvalu; United States Minor Outlying Islands; Vanuatu; Wallis and Futuna Islands.

*Latin America and the Caribbean*
Anguilla; Antigua and Barbuda; Argentina; Aruba; Bahamas; Barbados; Belize; Bolivia (Plurinational State of); Bonaire, Bouvet Island; Brazil; Chile; Colombia; Costa Rica; British Virgin Islands; Cayman Islands; Cuba; Curaçao; Dominica; Dominican Republic; Ecuador; El Salvador; Falkland Islands (Malvinas); French Guiana; Grenada; Guatemala; Guadeloupe; Guyana; Haiti; Honduras; Jamaica; Martinique; Mexico; Montserrat; Nicaragua; Panama; Paraguay; Peru; Puerto Rico; Saint Barthélemy; Saint Kitts and Nevis; Saint Lucia; Saint Martin (French Part); Saint Vincent and the Grenadines; Sint Eustatius and Saba; Sint Maarten (Dutch part); South Georgia and the South Sandwich Islands; Suriname; Trinidad and Tobago; Turks and Caicos Islands; United States Virgin Islands; Uruguay; Venezuela (Bolivarian Republic of).

*Northern America*
Bermuda; Canada; Greenland; Saint Pierre and Miquelon; United States of America.

### 2. Distribution of trachoma; vitamin A deficiency; diabetic retinopathy (WHO regions)

*African Region*
Algeria; Angola; Benin; Botswana; Burkina Faso; Burundi; Cameroon; Cabo Verde, Central African Republic; Chad; Comoros; Côte d'Ivoire; Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Eswatini; Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho; Liberia; Madagascar; Malawi; Mali; Mauritania; Mauritius; Mozambique; Namibia; Niger; Nigeria; Democratic Republic of the Congo; Rwanda; Sao Tome and Principe; Senegal; Seychelles; Sierra Leone; South Africa; Togo; Uganda; United Republic of Tanzania; Zambia; Zimbabwe.

*Region of the Americas*
Antigua and Barbuda; Argentina; Bahamas; Barbados; Belize; Bolivia (Plurinational State of); Brazil; Canada; Chile; Colombia; Costa Rica; Cuba; Dominica; Dominican Republic; Ecuador; El Salvador; Grenada; Guatemala; Guyana; Haiti; Honduras; Jamaica; Mexico; Nicaragua; Panama; Paraguay; Peru; Saint Kitts and Nevis; Saint Lucia; Saint Vincent and the Grenadines; Suriname; Trinidad and Tobago; United States of America; Uruguay; Venezuela (Bolivarian Republic of).

*South-East Asia Region*
Bangladesh; Bhutan; Democratic People's Republic of Korea; India; Indonesia; Maldives; Myanmar; Nepal; Sri Lanka; Thailand; Timor-Leste.

*European Region*
Albania; Andorra; Armenia; Austria; Azerbaijan; Belarus; Belgium; Bosnia and Herzegovina; Bulgaria; Croatia; Cyprus; Czechia; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; Iceland; Ireland; Israel; Italy; Kazakhstan; Kyrgyzstan; Latvia; Lithuania; Luxembourg; Malta; Monaco; Montenegro; Netherlands; North Macedonia; Norway; Poland; Portugal; Republic of Moldova; Romania; Russian Federation; San Marino; Serbia; Slovakia; Slovenia; Spain; Sweden; Switzerland; Tajikistan; Turkey; Turkmenistan; Ukraine; United Kingdom of Great Britain and Northern Ireland; Uzbekistan.

*Eastern Mediterranean Region*
Afghanistan; Bahrain; Djibouti; Egypt; Iran (Islamic Republic of); Iraq; Jordan; Kuwait; Lebanon; Libya; Morocco; Oman; Pakistan; Qatar; Saudi Arabia; Somalia; Sudan; Syrian Arab Republic; Tunisia; United Arab Emirates; Yemen.

*Western Pacific Region*
Australia; Brunei Darussalam; Cambodia; China; Cook Islands; Fiji; Japan; Kiribati; Lao People's Democratic Republic; Malaysia; Marshall Islands; Micronesia (Federated States of); Mongolia; Nauru; New Zealand; Niue; Palau; Papua New Guinea; Philippines; Republic of Korea; Samoa; Singapore; Solomon Islands; Taiwan; Tonga; Tuvalu; Vanuatu; Viet Nam.

## 3. Distribution of myopia; near vision impairment; moderate to severe vision impairment or blindness (Global Burden of Disease regions)

*Central Asia*
Armenia; Azerbaijan; Georgia; Kazakhstan; Kyrgyzstan; Mongolia; Tajikistan; Turkmenistan; Uzbekistan.

*Central Europe*
Albania; Bulgaria; Bosnia and Herzegovina; Croatia; Czechia; Hungary; Montenegro; North Macedonia; Poland; Romania; Serbia; Slovakia; Slovenia.

*Eastern Europe*
Belarus; Estonia; Latvia; Lithuania; Republic of Moldova; Russian Federation; Ukraine.

*Australasia*
Australia; New Zealand.

*High-income Asia Pacific*
Brunei Darussalam; Japan; Republic of Korea; Singapore.

*High-income North America*
Canada; United States of America.

*Southern Latin America*
Argentina; Chile; Uruguay.

*Western Europe*
Andorra; Austria; Belgium; Cyprus; Denmark; Finland; France; Germany; Greece; Greenland; Iceland; Ireland; Israel; Italy; Luxembourg; Malta; Netherlands; Norway; Portugal; Spain; Sweden; Switzerland; United Kingdom of Great Britain and Northern Ireland.

*Andean Latin America*
Bolivia (Plurinational State of); Ecuador; Peru.

*Caribbean*
Antigua and Barbuda; Bahamas; Barbados; Belize; Bermuda; Cuba; Dominica; Dominican Republic; Grenada; Guyana; Haiti; Jamaica; Puerto Rico; Saint Lucia; Saint Vincent and the Grenadines; Suriname; Trinidad and Tobago.

*Central Latin America*
Colombia; Costa Rica; El Salvador; Guatemala; Honduras; Mexico; Nicaragua; Panama; Venezuela (Bolivarian Republic of).

*Tropical Latin America*
Brazil; Paraguay.

*North Africa and Middle East*
Afghanistan; Algeria; Bahrain; Egypt; Iran (Islamic Republic of), Iraq; Jordan; Kuwait; Lebanon; Libya; Morocco; Oman; Qatar; Saudi Arabia; State of Palestine; Sudan; Syrian Arab Republic; Tunisia; Turkey; United Arab Emirates; Yemen.

*South Asia*
Bangladesh; Bhutan; India; Nepal; Pakistan.

*Central sub-Saharan Africa*
Angola; Central African Republic; Congo; Democratic Republic of the Congo; Equatorial Guinea; Gabon.

*Eastern sub-Saharan Africa*
Burundi; Comoros; Djibouti; Eritrea; Ethiopia, Kenya, Madagascar, Malawi, Mozambique; Rwanda; Somalia; South Sudan; Uganda; United Republic of Tanzania; Zambia.

*Southern sub-Saharan Africa*
Botswana; Eswatini; Lesotho; Namibia; South Africa; Zimbabwe.

*Western sub-Saharan Africa*
Benin; Burkina Faso; Cameroon; Cabo Verde; Chad; Côte d'Ivoire; Gambia; Ghana; Guinea; Guinea-Bissau; Liberia; Mali; Mauritania; Niger; Nigeria; Sao Tome and Principe; Senegal; Sierra Leone; Togo.

*East Asia*
China; Democratic People's Republic of Korea; Taiwan.

*Southeast Asia*

Cambodia; Indonesia; Lao People's Democratic Republic; Malaysia; Maldives; Mauritius; Myanmar; Philippines; Seychelles; Sri Lanka; Thailand; Timor-Leste; Viet Nam.

*Oceania*

American Samoa; Fiji; Guam; Kiribati; Marshall Islands; Micronesia (Federated States of); Papua New Guinea; Samoa; Solomon Islands; Tonga; Vanuatu.

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World Health Organization

Department of Noncommunicable Diseases

20 Avenue Appia
1211 Geneva 27
Switzerland
Phone +41 22 791 2881

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