Online Annex: Methodology for estimating the cost of addressing the coverage gap of services for addressable and preventable causes of vision impairment

The costing methodology follows best practices for constructing a price-tag. This annex describes the methodological choices and assumptions used.

The global price-tag addresses the coverage gap for services to prevent or address leading causes of moderate or severe vision impairment (MSVI) and blindness. This includes the costs of eye care-related services that are needed for two distinct groups of eye conditions. The first refers to the costs of the coverage gap for addressing MSVI and blindness due to unaddressed refractive error and unoperated cataract. The second is the costs that would have been required to prevent MSVI and blindness due to glaucoma, diabetic retinopathy and trachoma.

The perspective of the analysis is that of country-level health systems and costs for labor, facilities and consumables are included. Labor costs are based on International Standard Classification of Occupations (ISCO) skill levels 1-4 and WHO salary estimates for health workers from 2018. Facility costs were also taken from WHO estimates from 2018, while a range of sources were used as a reference for consumable costs (e.g. IAPB's Essential List for Cataract Surgery, Management Sciences for Health drug price indicator guide). The time horizon for the analysis is 'immediate', meaning that only costs associated with assessment, treatment and follow-up for each eye condition are considered.

The analysis assumes that the resource needs, in terms of health facilities (including overheads) and health workers, would be available. As such, a gap analysis was not conducted, nor were costs of building new facilities or training new health workers included. Therefore, the estimates presented herein reflect an underestimate of the total system costs[1] as it relies on additional investment to strengthen existing health systems.

Provisions were made to account for the large capital costs of ophthalmic equipment that are required for the management of diabetic retinopathy and glaucoma. While it is acknowledged that skills and resources required for the management of some eye conditions (e.g. refractive error) vary considerably between child and adult populations, data on the cause-specific number of people with MSVI or blindness are only widely available for adults aged 50 years and over. Thus, the assumptions applied in this analysis were based on provision of care to adults.

Table 1 outlines the population with MSVI or blindness from some preventable or addressable causes and the costing model pathway for each condition. Table 2 details the results of the costing exercise stratified by condition.

[1] The price tag is likely to be an underestimate given the exclusion of costs to build more health facilities and to train more health workers. In a study of the costs needed to build facilities and educate and train refractionists for unaddressed refractive error alone, Fricke et al. (2012) report a cost of US$ 28.5 billion, which includes all capital costs for investments in education and facilities and five years of facility running costs. These estimates are notably higher than that reported herein, highlighting that health system investments are also critical.

Table 1. The costing model pathway for each of the five conditions

Condition	Population	Assumptions used in the model pathway
Cataract	65.2 million people with moderate or severe distance vision impairment or blindness	Referral is performed under 2 main scenarios: a) referral to diagnosis and b) referral to care[1] A) Referral to diagnosis (60%) i. A nurse/ophthalmic assistant/general medical professional performs the referral (assumed each of these professions performs 33% of the total referrals). ii. Diagnosis/examination is by an optometrist (40%) or ophthalmologist (60%) in an outpatient setting. B) Referral to care (40%) i. An ophthalmologist or optometrist performs diagnosis and referral in outpatient settings (50% each). Surgery: • Cost of surgery is for phacoemulsification (55%) or manual small incision cataract surgery (45%) and a single vision intra-ocular lens for all settings. Prices were either taken from IAPB – Essential List for Cataract Surgery or sourced from the Management Sciences for Health (MSH) drug price indicator guide. • The model assumes that surgery is costed as requiring one pre-surgical examination and conducted in both eyes, with each eye operated on separate days, and 20% of persons will receive Yag capsulotomy post cataract surgery. • All patients are followed up a total of four times (2 times for each eye). • Post-operatively, 80% receive with ready-made spectacles for reading and 20% receive custom made progressive glasses. Total cost + 20% to account for the equipment investment required
Unaddressed Refractive Error	123.7 million people with moderate or severe distance vision impairment or blindness caused by unaddressed refractive error; and 826 million people with near vision impairment caused by unaddressed refractive error.	Different professions perform this initial examination. However, in terms of the model, these functions are similar, and represented by the same skill level (ISCO-3). Therefore, costs do not differ by income status of the country but rather by the countries' general pay rates for that skill level. <u>Distance vision impairment due to unaddressed refractive error:</u> • Examination time: 30 minutes • 60% receive ready-made spectacles; 20% custom made distance prescription only (costed for 10 minutes additional time); 20% custom made progressive glasses (cost for 10 minutes additional time and 4 x cost of single vision distance custom made spectacles). • Patients are examined and provided with replacement spectacles every 5 years on average for the remainder of their lives (LIC+LMIC = additional 4 examinations and 4 pairs of spectacles; HIC+UMIC = additional 6 examinations and 6 pairs of spectacles)[2] <u>Near vision impairment due to unaddressed refractive error</u>: • Examination time: 10 minutes • 97% of individuals receive ready-made spectacles (spherical lenses only) and 3% receive custom-made spectacles (costed for 10 minutes additional time).

		• Patients are provided with replacement spectacles every 5 years on average for the remainder of their lives (LIC+LMIC = additional 4 pairs of spectacles; HIC+UMIC = additional 6 pairs of spectacles) Total cost + 10% to account for the equipment investment required
Diabetic Retinopathy	3 million people with moderate or severe distance vision impairment or blindness due to diabetic retinopathy.	Referral is performed under 2 main scenarios: a) referral to diagnosis and b) referral to care A) Referral to diagnosis (40%) i. Performed by either a nurse, ophthalmologist, ophthalmic assistant, optometrist or other medical professional in equal proportions. ii. Diagnosis/examination is by an optometrist (40%) or ophthalmologist (60%) in an outpatient setting. B) Referral to care (60%) i. An ophthalmologist or optometrist performs diagnosis and referral in outpatient settings (50% each). Treatment components consist of: • 26% of patients receive anti-VEGF[3] and laser photocoagulation (2 sessions); • 26% receive anti-VEGF[3] only; • 48% receive laser photocoagulation only (2 sessions). Follow-up: • Patients are examined bi-annually for life in all scenarios, assumed to be 20 years from diagnosis for low- and low-intermediate resource settings and 30 years from diagnosis for high- to upper-intermediate resource settings. Total cost + 20% to account for the equipment investment required. Note: Management of diabetic retinopathy risk factors (e.g. hyperglycaemia and hypertension) were not costed in this analysis.
Trachoma	To prevent the current 2 million people with moderate or severe distance vision impairment or blindness due to trachoma, it was assumed that the current WHO SAFE strategy would need to be applied to all those at risk. That is, the distribution of antibiotics to 142 million people living in areas where the A, F and E components of SAFE are indicated, and addressing the need for care for the 2.5 million people with trachomatous trichiasis.	Mass distribution of azithromycin: • Assumed the cohort of persons (apart from those aged under 6 months) with active trachoma are treated using oral azithromycin. Children aged under 6 months receive tetracycline eye ointment (TEO). • Azithromycin is donated. • Most antibiotic treatment is delivered by community workers with financial unit costs of distribution assumed to be US$0.50. • All communities receive three to five years of annual mass distribution of azithromycin. • One Trachoma Impact Survey and one Trachoma Surveillance Survey undertaken within 1270 districts (est. USD 8,298 per survey). Surgery for trachomatous trichiasis[4]: • Assumed all people with trachomatous trichiasis (i.e. 2.5 million people) receive high quality surgery (@80USD per case). • Trachoma surgery is performed at primary care level (one session - two eyelids where required - per person). Assumed 10% recurrence due to progression of underlying scarring (@240USD per case).
Glaucoma	6.9 million people with moderate or severe distance vision	Referral: • Made by an optometrist or ophthalmologist in equal proportions.

	impairment or blindness due to glaucoma.	Diagnosis: • Made by an ophthalmologist and assistant in a 45-minute consultation. Treatment components consist of: • Single drug treatment (beta-blockers (30%) or prostaglandins (70%)) for life for 88% of patients. • Surgery[5] for 12% of patients. Of those who receive surgery 50% receive additional pharmacological treatment (beta-blockers (30%) or prostaglandins (70%)) and 50% will require a second surgery during their lifetime. Follow-up: • Patients are examined bi-annually for life in all scenarios, assumed to be 20 years from diagnosis for low- and low-intermediate resource settings and 30 years from diagnosis for high- to upper-intermediate resource settings. Total cost + 20% to account for the equipment investment required

[1]This analysis does not account for loss to follow-up from the point of referral to diagnosis and/or surgery, nor does it account for false positive cases.

[2]Based on an average care pathway for the estimated 123.7 million people aged 50 years and older with moderate or severe distance vision impairment or blindness caused by unaddressed refractive error. Given the resources required for the management of refractive error amongst child populations are considerably greater, this represents a conservative estimate only.

[3]The model assumes (1) an average treatment frequency of 7 injections in the first year, 2.5 in the second year, 1.5 in the third year and 0.5 in the fourth year; and (2) the use of ranibizumab (60% of cases) or bevacizumab (40% of cases).

[4]The case finding of trachomatous trichiasis was not costed in this analysis.

[5]Assumed selective laser trabeculoplasty as the main indication.

Table 2. Estimated costs of addressing the coverage gap of services to prevent or address MSVI and blindness, stratified by cause[2].

Condition	USD2018 (in thousands)
MSVI or blindness causes that are treatable or addressable	
Cataract	8,768,759
Unaddressed Refractive Error (Distance)	6,988,223
Unaddressed Refractive Error (Near)	9,035,476
Total	24,792,458
MSVI or blindness causes that are preventable	
Diabetic Retinopathy	19,858,251
Trachoma	494,077
Glaucoma	11,744,642
Total	32,096,970

[2] In the version of the World report on vision that was launched on the 9th of October 2019, the costs of the coverage gap for unaddressed refractive errors and cataract amongst adult populations globally were estimated to be $14.3 billion, while the costs of preventing the vision impairment amongst adults that was caused by glaucoma, diabetic retinopathy and trachoma were estimated to be US$5.8 billion. The revised costs presented herein are higher as the updated model takes into consideration (i) the need for spectacles post cataract surgery, (ii) the costs of re-examination and replacement spectacles over the life-course for those with refractive error, (iii) the large capital costs of ophthalmic equipment that are required for the diagnosis and management of cataract, refractive error, diabetic retinopathy and glaucoma and; (2) the use of ranibizumab in the treatment of diabetic macular edema in a large proportion of settings.