

Primary Eye Care Service in Rwanda: Benefits and Costs

An assessment of the value generated by and costs associated with the primary eye care programme provided by Vision for a Nation Foundation in conjunction with the Rwandan Ministry of Health - an updated analysis

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1. Background

Vision for a Nation (VFAN) is a UK registered charity with an ambitious mission to make eye examinations and affordable glasses available to all, starting in Rwanda. The Foundation has provided training to 1,300 nurses in Rwanda, initially in the existing health centres and now and going forward as part of the nursing syllabus, to provide eye examinations, dispense glasses or medication for easily treatable problems or refer onwards for other eye problems on a countrywide basis. As part of the programme, VFAN is donating low cost glasses and is now funding an outreach programme to ensure that those people unable to access the primary eye care service in health centres will nevertheless receive treatment in their village. This, together with an awareness-raising programme, also funded by VFAN, will ensure the widespread correction of refractive error and treatment of minor eye disease throughout the country. The primary eye care initiative has been developed in collaboration with the Rwandan Ministry of Health with whom VFAN has agreed a new and final Memorandum of Understanding (MoU) to cover their activities until the end of 2017.

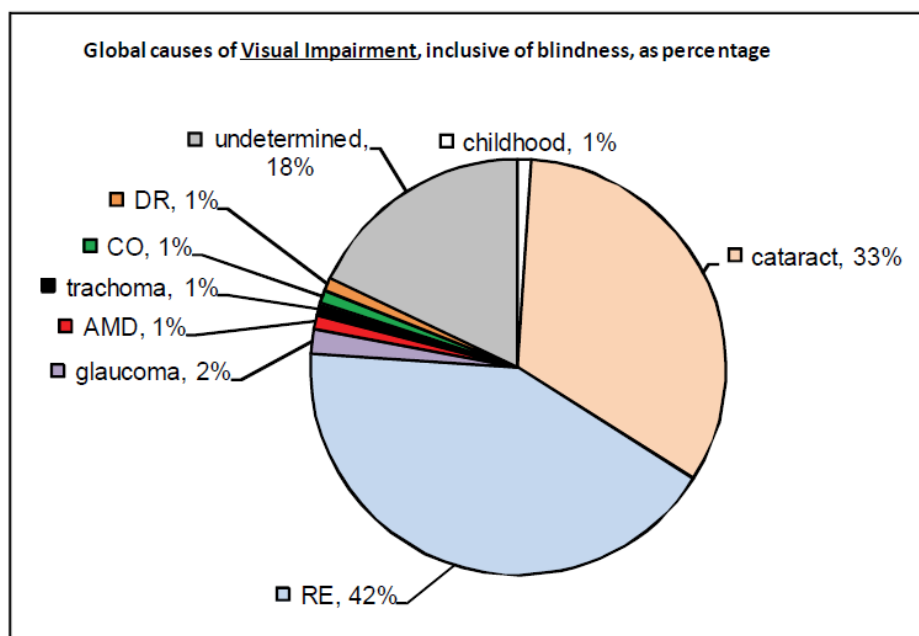
KEY FINDINGS: RWANDA - BENEFITS AND COSTS

- * The Rwandan Ministry of Health estimates that there are 1.2million people in Rwanda with uncorrected refractive error of whom approximately 1million are of working age. This is equivalent to a prevalence of 12% across the population.
- * The total cost of URE to Rwanda in terms of productivity loss to the national economy is estimated at US\$60 million per year.
- * The average productivity gains envisaged for patients tested and provided with glasses are estimated at 10% where the 2013 GDP per capita is US\$639². This is considered a conservative estimate of the productivity gains.
- * Prevention, early intervention and referral for cataract surgery and other serious eye conditions are key components of an eye care strategy.
- * The estimated net annual cost of the VFAN programme to deliver eye tests and corrective glasses, dispense medication and provide referrals for hospital care over the period 2015 - 2017 of the programme is projected to be between US\$3.45 million and \$3.76million which includes both the direct cost of the VFAN contribution and an estimate of the costs to the Rwandan Ministry of Health for the service covering both health centres and the outreach programme.
- * Based on projections, this annualised cost will enable the distribution of 387,000 – 597,000 glasses over the period June 2015 - December 2017, meeting between 30% and 47% of the total estimated country need.
- * The cost is small in relation to the potential productivity gains that could be generated through the provision of corrective eyeglasses alone. The additional benefits to individuals in terms of improved quality of life, enhanced educational opportunities and reduction in accidents and injuries add further value although this has not been quantified in monetary terms.

In 2014, VFAN commissioned an independent study to assess the costs and benefits associated with the primary eye care programme provided by VFAN in conjunction with the Rwandan Ministry of Health. This paper now takes account of the new MoU and actual programme data that has become available. The MoU provides for an extension of the programme with revised commitments in anticipation of a handing over of all responsibilities of the established and fully functioning primary eye care programme to the Rwandan Ministry of Health in 2017 and withdrawal by VFAN.

2. Introduction

Blindness and poor vision have devastating implications for individual sufferers, carers, dependents and society more widely. Most of the causes of blindness and visual impairment can be addressed through prevention and treatment. Cataract and uncorrected refractive error (URE) alone account for 75% of visual impairment globally¹⁴. The challenge in low income countries such as Rwanda is to overcome a complex set of seemingly intractable problems which include lack of infrastructure, shortage of specialist skills and resources, a geographically dispersed and largely rural population, poverty and lack of education to provide an effective eye care service for prevention and treatment. The gains from doing so are however extremely significant.



Global Data on Visual Impairments¹⁰

The literature on blindness and visual impairment⁶ makes the observation that it has significant implications for the quality of life for those who suffer, for their employment and educational opportunities, productivity at work, and for economies as a whole. In general terms there is agreement that the costs associated with visual impairment at a variety of levels are high and that there are considerable economic and social benefits to investing in

programmes to address blindness and low vision. PriceWaterHouseCoopers in a recent series of studies for the Fred Hollows Foundation, an NGO contributing to the elimination of blindness in Rwanda, have calculated that in low income countries, the benefits outweigh the costs by a factor of four¹⁷.

We explore below the different components of value created by addressing the problems of blindness and visual impairment. A conservative baseline estimate of value in monetary terms is used to allow a comparison with the costs of providing the PEC service in Rwanda.

3. The costs of blindness and visual impairment

“It is well recognized that disability is a cause and a consequence of poverty and inequality. People with disabilities and their families including the blind or visually impaired, are more likely to experience economic and social disadvantage. Many face barriers to participation in society, such as in accessing development programmes and funds and restrictions in communication, transport and mobility. Those impaired are more likely to experience unemployment, isolation and discrimination, food insecurity, poor housing, inadequate access to health care, safe water and sanitation, and they are less likely to attend school. “

The Fred Hollows Foundation (2012)⁵

The importance of an initiative to address visual impairment then is a critical factor in breaking the cycle of poverty that is exacerbated by ill health and disability enabling people to work and earn and hence to participate economically in society, spending, saving and investing for the future. This has implications at both the individual level and the societal level. Estimates for the annual productivity losses as a consequence of visual impairment range from \$2.6 - \$6 billion globally⁵.

4. An approach to understanding value

The burden of visual impairment derives from a number of different sources. These are summarised as follows:

- a. The loss in **productivity** (and hence income) of those in employment through having poor vision or through sufferers not being able to work productively at all,
- b. Loss of opportunity of people who may otherwise be in education or productive work in **caring** for people with vision impairment,
- c. Reduced **education opportunities** for young people with vision impairment,
- d. Cost of **accidents and injuries** through poor vision,
- e. Costs in terms of **quality of life**,
- f. Economic deadweight loss.

Frick, K.D. et al. (2010)⁷

Loss in productivity (a. above) is the most significant component of the calculation. A Guinea-based study of onchocerciasis on rural households found that while 98% of sighted people were economically active, only 62% with low vision and 21% of blind people were engaged economically⁵. The value of the impact on carers has been estimated to be at least 10% of one economically active member of the household or US\$4.4billion worldwide⁶.

Difficulties in quantifying the other components of the burden of visual impairment in monetary terms (c., d., e. and f. above) due to conceptual issues in valuation or simply lack of data make focusing on a. and taking account of b.: loss of economic productivity, the most practical approach. This provides a conservative and relatively non-controversial baseline against which to evaluate the costs of addressing the problem. This is consistent with an analysis from a societal perspective and is reasonable having regard to the nature of the health problem, the country setting and the data available.

5. The VFAN PEC Service

One of the challenges of addressing blindness and low vision in low income countries is finding a model which enables diagnostic and therapeutic eye care services to be rolled out to a geographically dispersed population in a context where there is a shortage of skills and resources. VFAN in conjunction with the Rwandan Ministry of Health has established an effective model through the training of health centre nurses to identify and treat common eye diseases and, through the dispensing of eyeglasses, address URE. Patients who cannot be treated at the health centre level are referred on for hospital treatment.

This model of primary eye care is described by Courtright et al.⁴ It includes checking the external eye for lid defects including trachomatous trichiasis, the cornea for corneal opacities and injuries, the conjunctiva for conjunctival conditions, and the pupil for cataracts as well as importantly, the assessment of visual acuity. In the case of the VFAN service, eyeglasses in the form of standard pre-made spectacles and adjustable glasses are also dispensed.

After three years, during which time the nursing curriculum was tested and the training rolled out, first to existing health centre nurses and then to nurses in training, the programme has demonstrated its potential to reach a large percentage of the population. The MoU recently agreed with the Rwandan MoH now takes the programme a step further, including an ambitious outreach programme to take the PEC service into every village in Rwanda to address the backlog of need. In addition to the training of health centre nurses and provision of eyeglasses, the programme includes a series of awareness raising initiatives to be held over the next two years to ensure that knowledge about the eye care service becomes widespread and people are encouraged to use it. This is considered an essential part of ensuring the success of the programme as research has shown that lack of education about the need for and availability of care means that use of the service would not be maintained⁴.

The provision of low cost eyeglasses by VFAN addresses the remaining issue - that of affordability. VFAN has sourced low cost glasses which are distributed through the Rwandan Ministry of Health's existing channels. These glasses have been donated as part of VFAN's contribution to the programme. The glasses are sold by the MoH to beneficiaries on a revenue-generating and financially self-sustaining basis on the understanding that proceeds of the sale of glasses goes towards a "revolving eye care fund" administered by the MoH to ensure the sustainability of the PEC programme and fund other aspects of eye care such as subsidies for customised glasses for children.

To better understand the value of the PEC service established by VFAN, it is now possible to look at the breakdown of services provided by the programme. The figures given in the table below are based on the breakdown of performance achieved in 2014 and the first half of 2015 which now form the basis of projections of the service over the period 2015 - 2017 contained in the MoU.

Projected breakdown of treatment/outcomes					
June 2015 – end 2017					
(000's)					
Action	Health Centre eye examinations	Village Outreach eye examinations		Total*	Total Upper Bound
		Conservative estimate*	Upper bound estimate		
Vision screenings	508	1,250	1,740	1,758	2,248
Eye drops / Medication	239	625	825	864	1,064
Dispensing of Eyeglasses	87	300	510	387	597
Referral for treatment / surgery	117	250	375	367	492
TOTAL interventions	950	2,425	3,375	3,375	4,325

* Conservative estimate based on a pilot of 11 villages and given as a commitment in the MoU.

Table 1.

The total number of people seen for eye examinations over the period June 2015 – end 2017 across the VFAN PEC service including the outreach programme is now expected to exceed 15% of the total population. This figure is believed to be realistic because of the considerable resources that VFAN is putting towards awareness raising in collaboration with the Rwandan Ministry of Health and the new outreach programme which will take the PEC service into villages across the country. The Rwandan Ministry of Health had projected a prevalence rate of URE (including presbyopia) of 12% across the population. This is consistent with the percentage of people seen within the PEC service to whom glasses were dispensed. This figure is also consistent with a finding in Benin¹⁶ and in a Tanzanian study of older age groups (>40years)¹⁵.

Under the category of 'Referrals to Hospitals', at present no further breakdown is provided. It is therefore difficult to look more closely at the categories of provisional referral diagnoses

although some assumptions can be made on the basis of available evidence. It has been widely documented that cataracts are one of the most common causes of preventable blindness¹⁸. This is supported by an assessment of the causes of visual impairment of people aged > 50 years in Western Rwanda¹¹ which found that cataracts accounted for the majority of cases of avoidable blindness. It is to be expected that this then will constitute a major reason for onward referral (globally, cataracts are 33% of all visual impairment).

The surgical treatment of cataracts has been widely shown to be safe, effective and cost effective in all settings including low income countries¹. The value of the referrals to hospital care is therefore undoubtedly economically significant and will become more so as surgical capabilities are expanded. The surgical treatment of cataracts is a key component of the Rwandan Ministry of Health's resourcing and facilitation plan for 2009 – 2013¹³ and while no validated information is available on cataract surgery rates in Rwanda at present it is assumed that levels have not risen to those that were planned for (1500 per million) and remain at low levels as a consequence of a shortage of appropriately trained medical practitioners, facilities and access by patients. Given the limited data available from the programme and the fact that hospital care does not fall directly within the scope of the PEC service, it would be difficult to impute a value to take into account at present. However the value of blindness avoided through cataract and trachoma surgery should ultimately be substantial.

The other category of treatment, dispensing of medication, is also difficult to evaluate. This includes treatment for conjunctivitis, trachoma and onchocerciasis and is important in prevention. Trachoma and onchocerciasis have a low prevalence in Rwanda¹¹ but this aspect of the service is nevertheless important. Problems such as conjunctivitis and less serious eye injuries can be debilitating and may also affect school attendance.

The PEC service dovetails with a number of other initiatives provided by the Rwandan Ministry of Health and other NGOs, specifically the Fred Hollows Foundation and Christoffel Blinden Mission International that provide other components of secondary and tertiary eye care³ in Rwanda.

Table 2. below looks more closely at VFAN's expenditure in relation to the work done under the programme using the markers:

- Number of vision tests
- Number of glasses distributed.

These are measures of the efficiency of the VFAN programme in achieving its aims.

During the period 2011-2014 when the groundwork for the PEC service was laid, relatively few vision screenings were done and glasses dispensed. At the time the focus was on establishing the model, training and capacity building. The figures for 2015-2017 show the 'benchmark' productivity of the service with a health centre-based service and the relative cost effectiveness of the new outreach service, on both a conservative and optimistic basis. Whereas the cost to VFAN per vision screening based at the health centres alone (2015-2017) is £1.56, the (marginal) cost of the outreach programme is £1.48 bringing down the

average cost to £1.50. Similarly the VFAN cost per pair of glasses dispensed in the health centre - only programme is £9.12 whereas the marginal cost in the outreach programme is £6.17 in a conservative view, bringing the average down to £6.83. These figures are reduced further under a more optimistic scenario.

Please note that in assessing the VFAN cost per of glasses distributed, no value is attributed to any of the other functions of the PEC service.

VFAN Budgeted Programme Statistics			
All figures in £			
	HC* only	HC* plus Outreach	
		Conservative	Upper bound
2011-2017			
Number of glasses distributed	131,558	431,558	641,558
As a percentage of the total population need based on 12% prevalence:	10.44%	34.25%	50.92%
VFAN investment per vision screening	3.09	2.26	1.83
VFAN investment per pair glasses distr'd	19.03	10.78	7.25
2015-2017			
VFAN investment per vision screening (Averaged over entire service)	1.56	1.50	1.21
VFAN investment per vision screening O/R only i.e.marginal cost to VFAN		1.48	1.11
VFAN investment per pair glasses distr'd (Averaged over entire service)	9.12	6.83	4.66
VFAN investment per pair glasses distr'd O/R only i.e.marginal cost to VFAN		6.17	3.85

* Health Centre

Table 2.

These figures are based on VFAN's budgeted figures for costs and PEC uptake. Where necessary figures have been extrapolated to facilitate analysis.

6. An evaluation of the PEC service based on URE

In view of the difficulties associated with valuing the medication dispensing and hospital referral aspects of the PEC service, an assessment based solely on the value of the part of the service that addresses URE gives a robust, highly defensible and conservative baseline measure of the benefit of the programme.

The WHO has quoted a headline estimate of US\$202 billion for productivity lost as a consequence of URE. This figure was calculated by Smith et al.²² in a comprehensive global study as the US\$ equivalent to International US\$ 269 billion. Adjusted for labour participation rates and employment rates this figure is reduced to I\$121.4 billion based on categories a. and b. above. It is based on an estimated 158.1 million cases of visual impairment due to uncorrected or under corrected refractive error in 2007. The specific calculations for the Africa region which includes Rwanda work out at a burden estimate of US\$13.5 million of lost annual productivity for Rwanda (based on Rwanda's 2012 GDP). This estimate however is based on data which differs markedly from current estimates discussed further below.

The 2014 evaluation used a similar methodology but more current data. Firstly Smith's study was based on URE prevalence figures of .82% of the total population which were drawn from a 2003 South African study focusing on the prevalence of refractive error in children up to age 15 (McCarty, 2006). In contrast, a baseline URE population prevalence of 12% forms the basis of the Rwandan National Strategic Plan for Eliminating Needless Blindness for the period 2009 - 2013. This population prevalence statistic is broken down in age bands with prevalence in age group 11-20 being 3%, ages 21-45, 10%, and over the age of 45, 70%. These prevalence statistics work out at 16% prevalence for the 11+ age group which is the main target of the VFAN/Ministry of Health primary care-based URE programme. Some studies suggest estimates at these levels may be reasonable¹⁵ however a review of studies quoted by McCarty¹² and Sherwin et al.²⁰ only serve to highlight the paucity of available evidence and the extent to which statistics vary widely between studies. The Sherwin et al. review notes the proportion of moderate visual impairment due to URE ranged from 12.3% to 57.1% in sub-Saharan studies of the 40+ age group²⁰. Patel et al.'s study in rural Tanzania¹⁵ found a prevalence rate of presbyopia of 62% while a 1990 study in Benin found that 12.8% needed eyeglasses¹⁶. High prevalence statistics are however widely quoted for other parts of the world, in particular the developed world. The prevalence figures used by Smith et al.²² are based on figures collected by Resnikoff in 2004¹⁹ which exclude presbyopia. Population statistics in age cohorts which have been aggregated to match the age bands for the prevalence statistics were derived from information on Rwanda provided by the US Census Bureau and adjusted pro rata to the population of 10.5 million registered in the 2012 census.

The WHO disability weights used in the study by Smith et al. for moderate to severe visual impairment which drive the productivity loss estimate were in the region of 0.244 to 0.282²². This is equivalent, in this context, to a productivity loss of 26.5% per person with URE. For purposes of the updated calculations, the average of the 2010 WHO disability weightings for low vision were used: 0.19 for severe and 0.03 for moderate poor vision, as a proxy for

productivity. This is consistent with the evidence from an unpublished Indian study cited by Silver et al.²¹ which quotes a 10% increase in productivity. On this basis the total cost of URE in Rwanda is estimated at US\$ 60 million lost economic productivity per year. This analysis is conservative having adjusted for employment rates and labour force participation. While this figure is calculated conservatively, it is highly sensitive to the specific estimates for productivity gain and prevalence used.

To the extent that the VFAN primary care-based eye service in Rwanda goes beyond the provision of eye glasses by addressing minor eye problems and referring people who suffer from other vision impairing eye problems for hospital care, the programme has additional value beyond addressing purely URE-related conditions. This additional value is assumed to be substantial as other eye diseases are implicated in severe vision impairment and blindness with important consequences in terms of loss of productivity.

7. Non-monetary benefits

In section 4. above, the various benefits that were derived from addressing visual impairment in a country such as Rwanda were summarised. It was noted that apart from productivity, the benefits were not easily calculated in monetary terms either for lack of information or conceptual difficulties. We consider here briefly the health benefits that accrue expressed in terms of Disability Adjusted Life Years (DALYs) averted.

The disability-adjusted life year (DALY) is a measure of overall disease burden, expressed as equivalent years lost due to ill-health, disability or early death. Disability is the predominant issue in the case of visual impairment with the latter less significant in the context of visual impairment as low vision or even blindness does not tend to be a significant cause of death on its own. A number of authors have calculated DALYs or (DALYs averted) on a global basis using regional data. Rwanda is included in the World Health Organisation Africa E region, categorised by high infant mortality and very high adult mortality. On the basis of their analysis, the PriceWaterHouseCoopers study evaluating the benefit of eliminating avoidable blindness and visual impairment notes that 94% of the world's DALYs averted associated with visual impairment are borne by developing countries¹⁷. Their figure given for WHO Africa Region E which includes Rwanda is 3.9 million DALYs averted based on 2004 figures.

Another analysis focusing on the burden of visual impairment (rather than the benefit of eliminating avoidable visual impairment) for Africa E region gives the value as 7.6 million DALYs using 2010 data⁹. To put the figures in context, the 2010 population for the Africa E region was approximately 446 million. As these figures were derived from aggregated population statistics and prevalence estimates for the region it is not possible break them down at the individual country level.

8. Programme costs

Fricke et al.⁸ in their 2012 paper which builds on that of Smith et al.²² calculate the global cost of addressing URE in a manner consistent with conventional WHO guidelines i.e. achieving staff complements in line with guidelines for trained doctors and ophthalmic technicians, including, where appropriate, establishing training facilities where none exist. Their conclusion was that the global cost of correcting URE-related vision impairment was US\$20 to 28 billion. These figures are however difficult to relate to specific country experiences as they cover countries ranging from the least developed to the most.

In the Rwandan context the VFAN programme in conjunction with the Rwandan Ministry of Health has facilitated the provision of a primary care-based service to address URE and, additionally, refer patients with vision impairment from other causes to hospital care. The annual costs of the primary care led service are summarised below in Table 3.. Note that this analysis is from the service provider's perspective. Costs to the individual of time spent in having an eye test and transport for instance have not been included.

Based on these calculations the average annual net cost of the programme over the period 2015 - 2017 is between US\$3.45 million and \$3.76million (see Appendix 1.). This figure is a net figure after offsetting income from the dispensing of eye glasses at approximately 1000 Rwf per pair to those that can afford to pay (approximately 80%). A large percentage of the programme costs derive from nursing staff costs which are borne by the Ministry of Health. The programme costs also include the cost of a series of awareness-raising initiatives which are an intrinsic part of the programme. These programme costs compare extremely favourably with the estimate of the gains of the programme relating to productivity.

Cost of VFAN – Rwandan Ministry of Health primary eye care programme (Service provider perspective)	
Costs of VFAN	This includes costs of establishing and running an organisation in Rwanda to provide training, liaising with the MoH, monitoring and evaluating the work. It also includes costs of publicising the primary care eye service across the country to advertise the service and encourage people to have their eyes tested.
Costs of eye glasses for distribution	Provision of eye glasses for those people who need them. It has been estimated that 95% require low-cost reading glasses and 5% will receive adjustable glasses. Eye glasses are donated by VFAN under the programme. Costs of the glasses are approximately \$0.46 per pair of reading glasses and \$4.00 per unit for adjustable glasses.
Cost of nurses	The cost of nurses required to do eye examinations and dispense glasses has been based on 20 minutes per person seen. Salaries have been estimated at average gross costs for the two senior bands of nursing seniority.
Cost of Community Health Workers	No additional costs have been included for CHWs as there are no direct payments.
Income from dispensing eye glasses	Recipients of glasses are required to pay approx. \$1.50 per pair unless they qualify for free glasses. It has been assumed that 80% of people pay for their spectacles. The proceeds from the sale of glasses go towards the Rwandan Government “Eye Care Revolving Fund”, which is used to provide free glasses for the poorest 20% and to help people in need to access referral-level ophthalmic services. For purposes of this analysis however, income from eye glasses has been deducted from the other costs of the programme to produce net costs.
Distribution costs	The Ministry of Health distributes the eye glasses through its existing nationwide medical distribution system. Marginal costs for this have not been included.

Table 3.

VFAN's total expenditure (actual and projected) over the 6 year period of the programme is as follows:

VFAN total programme expenditure				
(GBP)				
	Year	Health Centre	Outreach	Total expenditure
ACTUAL	2011	3,556	-	3,556
	2012	335,294	-	335,294
	2013	540,241	-	540,241
	2014	702,491	-	702,491
BUDGET	2015 - 2017	921,434	2,150,013	3,071,447
	Total	2,503,016	2,150,013	4,653,029

Table 4.

There are studies which have looked at a benefit / cost ratio of eye care services in various countries in the developing and developed world. It is not possible to look either at the total costs of eliminating avoidable blindness in Rwanda as data on services beyond those used in VFAN's programme are not available and difficult to estimate. However one can consider the costs of eliminating URE against the total costs of doing so to get a feel for the scale of benefit of the programme. The multiple of benefit to costs shows that even with a health centre-based service and looking narrowly at the returns based solely on the gains in economic productivity that result from addressing URE, the benefits exceed the costs. The degree to which this occurs increases significantly with the relatively lower costs of the outreach programme to 1.92 times under the conservative scenario.

9. Conclusion

The calculations of the costs of the primary care based eye care programme show that the programme is extremely worthwhile in relation to the conservative baseline estimates of productivity gains that would result were avoidable visual impairment be eliminated. The net cost of the programme at around US\$3.79 million per annum will conservatively produce gains equivalent to approximately US\$60 per person with URE based on the prevalence statistics used by the Government of Rwanda's Ministry of Health. The additional gains through prevention of non-URE eye disease, enhanced educational opportunities, quality of life and health and safety only add to the value.

APPENDIX 1

Costs of VFAN– Ministry of Health PEC Programme 2015 - 2017

	Costs – Conservative scenario (GBP) (average per annum)
Costs of VFAN (per budget)	1,023,816
Eye glasses dispensed	149,806 pairs
Income: eye glasses dispensing	119,845
No of eye tests	680,323
Cost of nurses	1,420,374
Total costs VFAN +MoH	2,444,190
Total net costs VFAN+MoH after income from glasses	2,297,403
Total net cost US\$ equivalent	3,446,104

Note: Assumed US\$/GBP exchange rate 1.50.

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