

**GIVING**  
what we can

# BLINDNESS



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# 1 INTRODUCTION

The World Health Organisation estimated in 2010 that 39 million people in the world are blind, with a further 246 million suffering from low vision.<sup>1</sup> PricewaterhouseCoopers revised that estimate to 32.4 million blind and a further 190.6 million suffering from low vision following new lower estimates from China.<sup>2</sup> The WHO blindness figure has remained relatively constant despite increasing population (particularly amongst those over 50, which make up 82% of those blind, despite only making up 19% of the population<sup>3</sup>) – in both 1990 and 2002 37-38 million people were blind,<sup>4</sup> although PwC's estimate suggests the rate is now declining quite rapidly.

90% of those visually impaired – those with low vision or suffering from blindness – live in the developing world.<sup>5</sup> Child blindness is also prevalent, with 19 million visually impaired and 1.4 million blind.<sup>6</sup> Blindness is most prevalent in the WHO Eastern Mediterranean and African regions, while visual impairment is most commonly found in India and China.<sup>7</sup>

Visual impairment is inevitably difficult to define because sight is difficult to measure, though the WHO defines it in terms of a 'visual acuity' score, with low vision covering categories 1 and 2 of visual impairment, and blindness encompassing categories 3 to 5 (where category 5 is no light perception in either eye).<sup>8</sup>

While some cases of visual impairment are unavoidable, it is estimated that as much as 80% is preventable.<sup>9</sup> PwC estimated that it would take \$392bn (on top of the current \$5.9tn) from 2011-2020 to eliminate avoidable blindness entirely, though only \$128.2bn to eliminate avoidable blindness in the low and middle income countries.<sup>10</sup> Beyond the direct impact of not being able to see, there are other effects which are more difficult to account for, such as the effects on self-esteem, productivity and discrimination suffered. The DALY weight, which attempts to include this, is around 0.19 for blindness and 0.03-0.19 for visual impairment,<sup>11</sup> dependent on severity. However, some diseases cause a lot of pain on top of blindness. Trachoma is regarded as particularly painful, with the literature assigning a weight of 0.6 for trachoma-induced blindness and around 0.24 for trachoma-induced visual impairment.<sup>12</sup>

Despite the high prevalence, high importance and high preventability of blindness, the area is still tractable, depending on the cause of blindness. This report examines just how tractable from a donor's perspective.

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<sup>1</sup> <http://www.who.int/mediacentre/factsheets/fs282/en/>

<sup>2</sup> [http://www.hollows.org.au/sites/default/files/pdfs/research/FHF\\_Price\\_of\\_Sight\\_Report\\_final\\_201302.pdf](http://www.hollows.org.au/sites/default/files/pdfs/research/FHF_Price_of_Sight_Report_final_201302.pdf)

<sup>3</sup> <http://www.who.int/mediacentre/factsheets/fs282/en/>

<sup>4</sup> <http://www.who.int/blindness/causes/trends/en/>

<sup>5</sup> <http://www.who.int/mediacentre/factsheets/fs282/en/>

<sup>6</sup> <http://www.who.int/mediacentre/factsheets/fs282/en/>

<sup>7</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf?ua=1>

<sup>8</sup> <http://apps.who.int/classifications/icd10/browse/2010/en#/H53-H54>

<sup>9</sup> <http://www.who.int/mediacentre/factsheets/fs282/en/>

<sup>10</sup> [http://www.hollows.org.au/sites/default/files/pdfs/research/FHF\\_Price\\_of\\_Sight\\_Report\\_final\\_201302.pdf](http://www.hollows.org.au/sites/default/files/pdfs/research/FHF_Price_of_Sight_Report_final_201302.pdf)

<sup>11</sup> Salomon, J.A., et al., *Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010*. Lancet, 2012. 380: p. 2129-43.

<sup>12</sup> <http://www.plosntds.org/article/metrics/info%3Adoi%2F10.1371%2Fjournal.pntd.0000460>

## 2 TYPES OF BLINDNESS

### 2.1 Cataract

#### 2.1.1 Background

Cataract is clouding of the lens of the eye which prevents clear vision.<sup>13</sup> It is responsible for at least 33% of global visual impairment and at least 51% of global blindness, according to the WHO.<sup>14, 15</sup> Risk factors include smoking, exposure to UV light, diabetes and high BMI.<sup>16</sup> Treatment is done via surgery, where the lens is removed and then replaced and a new one is inserted.<sup>17</sup>

#### 2.1.2 India's Cataract Blindness Control Programme. Case study by the Centre for Global Development

"In India in the early 1990s, it was estimated that more than 80 percent of blind people, or more than 10 million individuals, suffered from bilateral cataract, and another 10 million individuals had cataract in one eye.

In 1994, recognizing both the tremendous problem of adult blindness in India and the shortcomings in the existing cataract treatment program, the Cataract Blindness Control Program was begun in seven states in India where it was most concentrated. The program consisted of introducing a new, more effective surgical technique; shifting from a strategy of providing treatment in mass camps to one in which fixed sites were used; partnering with Aravind Eye Hospital and other nongovernmental organizations for delivery of services; and improving management and training at all levels.

The total cost of the project was about US\$136 million, with close to 90 percent coming from the World Bank and the remainder from the government of India. In some settings, costs were as low as \$10 per cataract operation, due to the efficiencies of high patient volume and the local production of high-quality artificial lenses. Overall, the cost-effectiveness of surgery in the South Asia region has been estimated at about \$60 per disability adjusted life year.

A cumulative total of 15.35 million cataract operations were performed within the seven years of the program, which was successful in improving the quality of care. Surgeries using the recommended technique increased from 3 percent before 1994 to about 42 percent (cumulative) between 1999 and 2002. Based on an estimated 3.5 million cataract surgeries in India in the year 2000, 320,000 people were saved from blindness."<sup>18</sup>

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<sup>13</sup> <http://www.who.int/blindness/causes/priority/en/index1.html>

<sup>14</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf?ua=1>

<sup>15</sup> The figures are lower estimates because around 20% of total visual impairment and total blindness has an undetermined cause

<sup>16</sup> <http://www.who.int/blindness/causes/priority/en/index1.html>

<sup>17</sup> <http://eyewiki.aao.org/Cataract#Management>

<sup>18</sup> [http://www.cgdev.org/doc/millions/MS\\_case\\_19.pdf](http://www.cgdev.org/doc/millions/MS_case_19.pdf)

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Below is a table with pessimistic, moderate and optimistic estimates for the \$/DALY figure of the program, and the assumptions leading to those estimates:

Parameter	Pessimistic	Moderate	Optimistic
1: Cost (possible underestimate) <sup>19</sup>	136,000,000	136,000,000	136,000,000
2: Blindness cases averted <sup>20</sup>	1,120,000	1,680,000	2,240,000
3: Average number of years of blindness averted <sup>21</sup>	6	10	15
4: Average sight improvement (in DALY weight) per blindness case averted <sup>22, 23</sup>	0.06	0.1	0.15
5: DALYs averted from blindness (2 x 3 x 4)	403,200	1,680,000	5,040,000
6: Cataract surgeries on people with low vision <sup>24</sup>	5,000,000	6,250,000	7,675,000
7: Proportion of surgeries successful <sup>25</sup>	0.5	0.6	0.8
8: Average sight improvement (in DALY weight) after a successful surgery <sup>26</sup>	0.01	0.02	0.03
9: Average years of low vision averted per successful surgery <sup>27</sup>	6	10	15
10: DALYs averted from low vision (7 x 8 x 9)	150,000	750,000	2,763,000
11: DALYs averted (5 + 10)	553,200	2,430,000	7,803,000
\$/DALY (1 ÷ 11)	246	56.0	17.4

Note that this excludes benefits such as increased productivity, which the DALY weight cannot account for.

<sup>19</sup> [http://www.cgdev.org/doc/millions/MS\\_case\\_19.pdf](http://www.cgdev.org/doc/millions/MS_case_19.pdf). There was already existing eye care – albeit much worse – which may mean less had to be spent to set this up (e.g. less training). However, it is unclear whether this is significantly different from other countries systems.

<sup>20</sup> 320,000 blindness cases were averted in 2000 (Ibid). Given this number increased over the program (1994-2001), pessimistically we can estimate an average of 160,000 per year, up to 320,000 per year optimistically

<sup>21</sup> Note that cataract is associated with age, hence the low figures. A meta-analysis found two figures of 5 and 12 years respectively (Lansingh et al 2007) However, from page 3 of the CGDev report: “Cataract hits people earlier in life than in most other parts of the world. Almost half (45 percent) of cataract cases in India occur before 60 years of age (...) Because of the relatively early onset, those affected with cataracts face many years of severe vision loss and/or blindness”, so in this case the estimates should be revised up from 5 and 12.

<sup>22</sup> The DALY weight for blindness is 0.19. However, a patient can still suffer from visual impairment (DALY weight 0.03-0.19) and avoid blindness, so the quality of life improvement is not 0.19

<sup>23</sup> 3 x 4 and 8 x 9 gives the average DALYs averted per patient, respectively 0.3, 1, 2.4 for blind patients and 0.05, 0.12, 0.45 for those with low vision. Estimates in a systematic review (Lansingh et al 2007) give a range of 0.17-1.92, so this is consistent with it (and should, if anything, be higher due to longer life remaining). It also cited 0.92 QALYs gained for the second eye, which again is consistent, and if anything the estimates above are pessimistic here.

<sup>24</sup> [http://www.cgdev.org/doc/millions/MS\\_case\\_19.pdf](http://www.cgdev.org/doc/millions/MS_case_19.pdf) - note that this attempts to exclude surgeries on blind people. The report says 15.35m surgeries were done and that there are 10m with cataract in both eyes (i.e. blind) and 10m with cataract in one eye, so a best guess is that half of all surgeries were done on low vision. Arguments could be made either way to raise or lower the figure (for example, lower: blind people will have a stronger urge to go than people with low vision, raise: blind people will have more trouble getting there). However, also note that, from the report (p6): “patients blind in both eyes ... were given preferential access to services”. An optimistic estimate therefore is half of the total surgeries, with the other two estimates lower.

<sup>25</sup> DCP3 references a study in Sweden, stating “The results indicate that 80 percent of patients expressed improved visual function at the latest follow up” (7 years after surgery). The quality of surgeon is likely better in Sweden, and it is just one study, so pessimism has been added.

<sup>26</sup> The DALY weights for low vision range from 0.03 to 0.19. However, note that operating on one eye is still likely to leave that eye worse than the other eye, and so have a relatively small effect, reflected in the weights.

<sup>27</sup> See footnote 22 – I don’t think there’s a good reason to significantly change from that estimate

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### 2.1.3 Cost-effectiveness

Below are estimates from different sources (in \$/DALY averted):

- Estimate from India's Cataract Blindness Control Program (above) (69% coverage): 17.4-246. Assuming normal life expectancy after surgery, rather than the higher estimates used because of India's situation, then these estimates would range from 20.9-328.
- Copenhagen Consensus Centre (95% coverage): 137 in WHO Africa Region, 114 in WHO South East Asia Region.<sup>28</sup> This is taken from a probabilistic analysis by Baltussen and Smith (2012),<sup>29</sup> which compares a large number of interventions, presumably resulting in lower robustness of individual estimates. The paper's methodology states it uses a systematic review from Cochrane Summaries, which we have been unable to trace.
- Disease Control Priorities Project 2: <200 in low and middle income countries,<sup>30</sup> based on Baltussen et al (2004). Chao (2014) adjusts the paper for inflation and puts the figure at 17-104 (depending on region).<sup>31</sup>
- Disease Control Priorities Project 3, draft: Cites 5 papers (2002-6) ranging from 1,928-13,108 (\$/QALY rather than \$/DALY averted).<sup>32</sup> However, this includes developed countries: the only research done in a developing country (Nigeria) ranged from 1,928 to 2,975. Further, the sample size of that paper was 28, and the paper was designed to test the efficacy of two different forms of eye drops for patients who had surgery.<sup>33</sup>
- Systematic review (linked by the WHO; 2007): 54-139 (80% coverage with ECCE (a more effective surgery method than ICCE<sup>34</sup>), excluding Europe and the Americas), otherwise, \$54-269 (80 or 95% coverage ICCE or ECCE, excluding Europe and the Americas).<sup>35</sup>
- Systematic review from 2014: In 2014 US\$, \$/DALY ranges from 4.3-1013.7.<sup>36</sup> Excluding China and papers cited above (by DCP2 and CCC), the figure ranges from 4.3-74.
- WHO-CHOICE (2000): 89-91 for ECCE, 158-161 for ICCE (at 95 and 80% coverage respectively).<sup>37</sup>

These estimates align well with each other (excepting DCP3), and suggest the most likely figure is somewhere around \$40-150, with \$90/DALY around the median of each of the estimates, **a figure promising enough to be worth investigating further**. Whether there are such charities will be reviewed later. The India case study also provides a track record that makes this intervention even more encouraging.

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<sup>28</sup> <http://www.copenhagenconsensus.com/sites/default/files/chronicdiseaseperspectivepaper2.pdf>

<sup>29</sup> <http://researchonline.lshtm.ac.uk/61684/1/bmj.e615.pdf>

<sup>30</sup> <http://www.dcp-3.org/sites/default/files/dcp2/DCP50.pdf>

<sup>31</sup> <http://www.thelancet.com/pdfs/journals/langlo/PIIS2214109X1470213X.pdf>

<sup>32</sup> [http://www.dcp-3.org/sites/default/files/chapters/V9C11PRAJNA\\_DRAFT081513.pdf](http://www.dcp-3.org/sites/default/files/chapters/V9C11PRAJNA_DRAFT081513.pdf)

<sup>33</sup> <http://europepmc.org/abstract/MED/15627154>

<sup>34</sup> ICCE (intra-capsular cataract extraction) is where the whole lens is removed from the eye (and then corrected with 'aphakic' glasses), while ECCE (extra-capsular cataract extraction) is where the lens and front portion of the capsule are removed, and replaced by an artificial lens. Source: Baltussen (2004)

<sup>35</sup> [http://www.who.int/blindness/cost\\_cataract.pdf](http://www.who.int/blindness/cost_cataract.pdf)

<sup>36</sup> <http://www.thelancet.com/pdfs/journals/langlo/PIIS2214109X1470213X.pdf>

<sup>37</sup> [http://www.who.int/choice/results/blind\\_afrd/en/](http://www.who.int/choice/results/blind_afrd/en/)

## 2.2 Trachoma

### 2.2.1 Background

Trachoma is the result of infection of the eye with *Chlamydia trachomatis*.<sup>38</sup> If the infection is left untreated and the eye is re-infected, it can cause the eyelid to turn inwards, meaning that eyelashes come into contact with the eye, causing scarring, immense pain and eventually irreversible blindness.<sup>39</sup> It can be transferred from hands or clothing (via coming into contact with poor quality water) or flies. It is responsible for about 1% of global visual impairment and 3% of global blindness.<sup>40</sup> Generally, infection first occurs as a child, but blindness then occurs in adulthood (around 30-40 years of age).<sup>41</sup> It is estimated to cost \$2.9bn globally in lost productivity every year even though it would cost \$748m to eradicate it in two thirds of the suspected endemic regions.<sup>42, 43</sup>

As there are a number of causes and a number of steps the organism takes to infection, there are a number of approaches. One approach is to improve water quality via improved sanitation and improved disposal of waste, to prevent people from coming into contact with the organism. Equally, one could encourage people to improve facial cleanliness, so that even if the organism gets onto their hands it doesn't make it to the eye. Further, one could provide antibiotics to a community to prevent or alleviate infection. Finally, if prevention fails, one can then perform surgery, though this is only possible on those who are not blind, and is more successful the earlier it is done. The WHO recommended strategy for combatting trachoma is 'SAFE' – surgery, antibiotics, facial cleanliness and environmental changes.<sup>44</sup>

### 2.2.2 Morocco's National Blindness Control Programme, using the SAFE strategy. Case study by the Centre for Global Development

“Health condition: in 1992, a national survey found that just over 5 percent of Morocco's population had the blinding disease trachoma. Nearly all the cases were concentrated in five poor, rural provinces in the southeast of the country where 25,000 people showed a serious decline in vision due to trachoma, 625,000 needed treatment for inflammatory trachoma, and 40,000 urgently needed surgery.

Intervention or program: in 1991, Morocco formed the national Blindness Control Program to eliminate trachoma by 2005. Between 1997 and 1999, the program implemented a new strategy called SAFE (surgery, antibiotics, face washing, and environmental change), giving Morocco the distinction as the first national-level test of the 4-part strategy. Mobile teams have performed simple, inexpensive surgeries in small towns across the provinces, 4.3 million treatments of the antibiotic azithromycin have been distributed, health education efforts promoting face washing and hygiene have been conducted, latrines have been constructed, and safe drinking water supplied.

Cost and cost-effectiveness: the Moroccan government has provided the bulk of the financing for the program, with external support from the United Nations Children's Fund and a public-private partnership called the international trachoma initiative. Through this partnership, the pharmaceutical company Pfizer

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<sup>38</sup> <http://www.who.int/topics/trachoma/en/>

<sup>39</sup> [http://www.who.int/water\\_sanitation\\_health/diseases/trachoma/en/](http://www.who.int/water_sanitation_health/diseases/trachoma/en/)

<sup>40</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf?ua=1>

<sup>41</sup> [http://www.who.int/water\\_sanitation\\_health/diseases/trachoma/en/](http://www.who.int/water_sanitation_health/diseases/trachoma/en/)

<sup>42</sup> <http://trachoma.org/world%E2%80%99s-leading-cause-preventable-blindness>

<sup>43</sup> [http://trachoma.org/sites/default/files/guidesandmanuals/2020INSight\\_EnglishLR.pdf](http://trachoma.org/sites/default/files/guidesandmanuals/2020INSight_EnglishLR.pdf)

<sup>44</sup> [http://www.who.int/water\\_sanitation\\_health/diseases/trachoma/en/](http://www.who.int/water_sanitation_health/diseases/trachoma/en/)

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has donated over \$72 million worth of its antibiotic Zithromax®. Impact: overall, the prevalence of active disease in children under 10 has been reduced by 99 percent since 1997.”<sup>45</sup>

### 2.2.3 Cost Effectiveness (\$/DALY)

#### 2.2.3.1 S (Surgery)

- Disease Control Priorities Project 2: 4-82.<sup>46</sup>
  - Cites a paper by Baltussen (2005)<sup>47</sup> which estimates, for surgery (80% coverage), the figure is between 13 and 78 across global regions (and conducts a literature review to obtain those estimates).
- DCP3 (draft), CCC: Not addressed
  - However, the paper CCC sites for cataract – Baltussen et al 2012 – puts the figure at 83-222 (adjusted for inflation by Chao (2014)) in Sub-Saharan Africa and 335-998 in South East Asia.
- Systematic Review (Chao (2014)): **Beyond the papers mentioned above, this review cites an additional study which has a figure of \$39-123/HALY. This was a study conducted in 1996, though the paper was of high quality.**<sup>48</sup>
- WHO-CHOICE (2000): 13.<sup>49</sup>

The figure seems relatively consistent around \$50-100/DALY. Like cataract surgery, this is a promising enough to be worth looking into. The International Trachoma Initiative (ITI) does point out several barriers, though: the need for training more operators, the high attrition rate for surgeons, cultural barriers (e.g. fear of surgery), assessing burden of trichiasis in remote areas, and the legality of using operators who aren't physicians.<sup>50</sup> Some of the above estimates may try to account for this, but it is unlikely it will adequately account for all such costs, so we should treat the above figures with additional caution.

#### 2.2.3.2 A (Antibiotics)

- Disease Control Priorities Project 2: >4,100 for azithromycin, >9,600 for tetracycline<sup>51</sup>
- CCC: Not addressed
  - However, the reference for the effectiveness of surgery also considers antibiotics and the combination of surgery and antibiotics. The only one it reports including antibiotics – and it only includes the most effective ones – is 95% coverage with a combination of antibiotics and surgery, which has an average \$/DALY figure of 800.<sup>52</sup>
- WHO-CHOICE: 9,012-22,250<sup>53</sup>. Note that when antibiotics were done in combination with surgery, the figure drops dramatically to 170-600 – an indication of how much more effective and

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<sup>45</sup> [http://www.cgdev.org/doc/millions/MS\\_case\\_10.pdf](http://www.cgdev.org/doc/millions/MS_case_10.pdf)

<sup>46</sup> <http://www.ncbi.nlm.nih.gov/pubmed/16019692>

<sup>47</sup> <http://researchonline.lshtm.ac.uk/61684/1/bmj.e615.pdf>

<sup>48</sup> <http://www.thelancet.com/pdfs/journals/langlo/PIIS2214109X1470213X.pdf>

<sup>49</sup> [http://www.who.int/choice/results/blind\\_afrd/en/](http://www.who.int/choice/results/blind_afrd/en/)

<sup>50</sup> [http://trachoma.org/sites/default/files/guidesandmanuals/2020INSight\\_EnglishLR.pdf](http://trachoma.org/sites/default/files/guidesandmanuals/2020INSight_EnglishLR.pdf)

<sup>51</sup> <http://www.dcp-3.org/sites/default/files/dcp2/DCP50.pdf>

<sup>52</sup> <http://researchonline.lshtm.ac.uk/61684/1/bmj.e615.pdf>

<sup>53</sup> [http://www.who.int/choice/results/blind\\_afrd/en/](http://www.who.int/choice/results/blind_afrd/en/)



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important surgery is.

- Cochrane Summary: 6 out of 9 trials showed antibiotics reduced active trachoma at 3 months, 3 out of 6 trials showed antibiotics reduced active trachoma at 12 months.<sup>54</sup> The paper also states “all of the studies were of poor to moderate quality”.

These papers point to antibiotics reducing active trachoma, but not effectively enough to be worth funding by itself. Whether it is worth funding as part of the SAFE strategy shall be addressed later.

### *2.2.3.3 F (Facial Hygiene)*

- Cochrane Summary: “Evidence from one trial suggests that face washing can be effective in increasing facial cleanliness and in reducing severe trachoma, but its effect in reducing active trachoma is inconclusive. In another trial, there was no evidence of effect of face washing alone or in combination with tetracycline in reducing active trachoma in children with already established disease.”<sup>55</sup>
- GiveWell adds: “One study compared three pairs of villages and found a statistically significant effect for facewashing on reducing severe trachoma but not non-severe trachoma. Another compared eye washing and antibiotics to no treatment or antibiotics alone, and found no statistically significant benefit of eye washing.”<sup>56</sup>

A review of the SAFE strategy says:

“However, caveats in place, many cross-sectional surveys have shown that children with clean faces are less likely to have trachoma, and are less likely to have severe trachoma, with some studies reporting a more than threefold increased prevalence of active disease in children with dirty faces.”<sup>57</sup>

It does, however, also say that:

“An intervention study in Tanzania tested the effect of facial cleanliness promotion on trachoma prevalence in children. Six villages were selected and put into three pairs, one of each pair to receive mass topical antibiotics and the other to receive topical antibiotics as well as intensive health education about the importance of face washing in children. 1417 children aged 1–7 years were included. At baseline, only 18% of children in the intervention villages and 19% in the control villages had clean faces, and after 1 year of follow-up this proportion had increased to 35% of children in the intervention villages and 26% in control villages. The prevalence of clean faces had, therefore, doubled in the intervention villages, yet two in three children still had unclean faces. The inability to substantially increase the prevalence of clean faces was offered as the explanation for the lack of significant effect on the prevalence of trachoma, although the prevalence of severe trachoma was significantly lower in the intervention than control villages at the end of follow-up. The high cost of this behavioural intervention could limit its applicability to non-research settings.”<sup>58</sup>

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<sup>54</sup> <http://files.givewell.org/files/DWDA%202009/Interventions/Sumamo%202007-Trachoma%20umbrella%20review.pdf>

<sup>55</sup> <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003659.pub3/full>

<sup>56</sup> <http://www.givewell.org/international/technical/programs/SAFE>

<sup>57</sup> <http://www.sciencedirect.com/science/article/pii/S1473309903006595>

<sup>58</sup> <http://www.sciencedirect.com/science/article/pii/S1473309903006595>

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It is difficult to get an exact figure on the effectiveness of facial hygiene interventions. However, it will inevitably be difficult to create long-lasting habits for many people cheaply, and the evidence behind the intervention is weak. It is likely to have a positive effect, though perhaps not enough to be very effective.

One final point to note is that we have also done separate research into facial hygiene as part of our Water, Sanitation and Hygiene (WASH) research. This had a figure of \$3.35/DALY – an incredible figure – but with severe caveats.<sup>59</sup> Nevertheless, this is enough to at least be optimistic about its effectiveness.

### *2.2.3.4 E (Environmental Change)*

- Cochrane Summary: “There is some evidence from two trials that insecticides are effective in reducing trachoma, however, this effect was not demonstrated in another trial that used insecticides. Two trials on latrine provision as a fly control measure have not demonstrated significant trachoma reduction. Health education had shown significant reduction of trachoma in one study but another study did not demonstrate similar findings. Generally there is a dearth of data to determine the effectiveness of all aspects of environmental sanitation in the control of trachoma.”<sup>60</sup>

Giving What We Can has also done some research into sanitation promotion, again as part of WASH. There is a \$/DALY figure of 11, yet again a very promising figure with strong caveats.<sup>61</sup> It is again enough to avoid pessimism about the effect of its inclusion as part of a strategy for reducing trachoma; it is unlikely to be effective purely in terms of reducing trachoma incidence, but is effective because of the many other benefits it provides.

### **2.2.4 SAFE or just S?**

The WHO recommends SAFE to eliminate trachoma. The SAFE strategy is likely a very good way to eradicate trachoma, as it combines several interventions that all help to reduce the burden from trachoma.

However, this does not mean it is best for donors, with much more limited resources than the WHO, to focus on eradication. Donors should try and find the best things to do at the margin, which appears to be surgery. By funding the SAFE strategy, donors won't make it much easier to eradicate the disease because of the limited funding donors can give. Further, there are concerns about room for more funding with the SAFE strategy – antibiotics, facial hygiene and environmental change all involve relatively large-scale interventions, and so are likely to either be fully funded, or too far off funding for donors to make the difference. Antibiotics are mass-distributed, facial hygiene interventions involve mass education, and environmental change involves large projects, such as improving sanitation.

Surgeries, on the other hand, seem easier to effect on the margin, by providing funding for additional surgeries or by supporting the operations of individual eye care services (i.e. one hospital). In addition, surgeries are the main way of treating trachoma, whereas antibiotics, facial hygiene and environmental change are all more focussed on prevention. To eliminate trachoma, we need to treat those who suffer from it, and prevent future people from being infected – which means surgery is a prerequisite for any eradication program, unlike the rest, as they can be replaced by other components of the SAFE strategy.

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<sup>59</sup> <http://www.givingwhatwecan.org/research/charities-area/water-sanitation-and-hygiene-wash>

<sup>60</sup> <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004003.pub4/abstract;jsessionid=2664BEA388FE16134D6223155A.BCA191.f03t04>

<sup>61</sup> <http://www.givingwhatwecan.org/research/charities-area/water-sanitation-and-hygiene-wash>

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However, there are the aforementioned reasons to be sceptical of the cost-effectiveness of surgery. Nevertheless, it is worth investigating charities to see if any focus heavily on trachoma surgery, and whether they do so in an effective manner.

### **2.3 Onchocerciasis (River blindness)**

#### **2.3.1 Background**

To quote the WHO's pleasant description:

"Onchocerciasis is a parasitic disease caused by the filarial worm *Onchocerca volvulus*. It is transmitted through the bites of infected blackflies of *Simulium* species, which carry immature larval forms of the parasite from human to human. In the human body, the larvae form nodules in the subcutaneous tissue, where they mature to adult worms. After mating, the female adult worm can release up to 1000 microfilariae a day. These move through the body, and when they die they cause a variety of conditions, including blindness, skin rashes, lesions, intense itching and skin depigmentation."<sup>62</sup>

Onchocerciasis is responsible for 0.8% of global visual impairment (1.5 million) and 4% of blindness (0.6 million).<sup>63, 64</sup> It is also regarded as particularly painful and debilitating: onchocerciasis-induced visual impairment has a DALY weight of 0.26 and blindness has a DALY weight of 0.6.<sup>65</sup> Prevention is possible by using insecticide spray, in order to kill the larvae before they can infect people. Another approach is to use ivermectin yearly, a drug which also has a positive effect on lymphatic filariasis, another neglected tropical disease.

#### **2.3.2 Onchocerciasis Control Programme in Western Africa. Case study by the Centre for Global Development**

"Health condition: In 11 west African countries in 1974, nearly 2 million of the area's 20 million inhabitants were infected with onchocerciasis, and approximately 200,000 were blind.

Intervention or Program: The Onchocerciasis Control Program (OCP) was launched in 1974 in 11 west African countries. Weekly aerial spraying with environmentally safe insecticides helped control the disease vector—blackflies that bred in fast-moving waterways, thereby halting transmission of the disease. In 1995, a second program, the African Programme for Onchocerciasis Control (APOC), was established to control the disease in 19 central, east, and southern African countries. Through a broad international partnership and the participation of 115,000 remote, rural communities, APOC and OCP distributed a drug donated by Merck & Co., Inc., Mectizan (ivermectin), to more than 45 million people in sub-Saharan Africa in 2005. The drug prevents and alleviates the symptoms of the disease with one annual dose.

Cost-effectiveness: OCP operated with an annual cost of less than \$1 per protected person. Commitments from 27 donors during the 28-year project totaled \$600 million. The annual return on investment was calculated to be about 20 percent, primarily attributable to increased agricultural output; about \$3.7 billion will be generated from improved labor and agricultural productivity. The annual cost of

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<sup>62</sup> <http://www.who.int/topics/onchocerciasis/en/>

<sup>63</sup> <http://www.who.int/blindness/causes/en/>

<sup>64</sup> [http://www.cgdev.org/doc/millions/MS\\_case\\_7.pdf](http://www.cgdev.org/doc/millions/MS_case_7.pdf)

<sup>65</sup> <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2100367/table/pntd-0000114-t001/>

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APOC operations, taking into account the donation of all needed drugs, is approximately \$0.58 per person treated.

Impact: OCP produced an impressive change in health between 1974 and 2002: Transmission of the disease-causing parasite was halted in 11 west African countries, 600,000 cases of blindness were prevented, and 22 million children born in the OCP area are now free from the risk of contracting river blindness. About 25 million hectares of arable land—enough to feed an additional 17 million people per annum—is now safe for resettlement. APOC is expanding this success to central, east, and southern Africa, where 54,000 cases of blindness are expected to be prevented each year.<sup>66</sup>

From this, we can estimate the cost-effectiveness of the program. There are many factors omitted from this which would make the program even more cost-effective (onchocerciasis is linked to a decrease of life expectancy of 7-12 years,<sup>67</sup> and eradication has significant economic benefits):

Parameter	Pessimistic	Moderate	Optimistic
1: Cost <sup>68</sup>	600,000,000	600,000,000	600,000,000
2: Blindness cases averted <sup>69</sup>	600,000	600,000	600,000
3: Average number of years of blindness averted <sup>70</sup>	8	12	16
4: DALY weight of blindness from onchocerciasis <sup>71</sup>	0.6	0.6	0.6
5: DALYs averted from blindness (2 x 3 x 4)	2,880,000	4,320,000	5,760,000
6: Low vision cases averted <sup>72</sup>	900,000	1,500,000	2,100,000
7: DALY weight of low vision from onchocerciasis <sup>73</sup>	0.24	0.24	0.24
8: Average years of low vision averted per successful surgery <sup>74</sup>	8	12	16
9: DALYs averted from low vision (6 x 7 x 8)	1,728,000	4,320,000	8,064,000
10: DALYs averted (5 + 9)	4,608,000	8,640,000	13,824,000
\$/DALY (1 ÷ 10)	130	69.4	43.4

### 2.3.3 Cost-effectiveness (\$/DALY)

<sup>66</sup> [http://www.cgdev.org/doc/millions/MS\\_case\\_7.pdf](http://www.cgdev.org/doc/millions/MS_case_7.pdf)

<sup>67</sup> [http://eyewiki.aao.org/Onchocerciasis\\_\(African\\_River\\_Blindness\)](http://eyewiki.aao.org/Onchocerciasis_(African_River_Blindness)). Assuming that eradicating onchocerciasis increases life expectancy by 3-8 years (less than 7-12 since partly the reason will be, e.g., poorer water quality and other factors), affecting 1.5-2.7 million (2 + 6), this leads to an additional 4.5-21.6 million years of life per generation of onchocerciasis sufferers. For one generation, this is \$27.8-150 per year of life, excluding all other benefits

<sup>68</sup> [http://www.cgdev.org/doc/millions/MS\\_case\\_7.pdf](http://www.cgdev.org/doc/millions/MS_case_7.pdf)

<sup>69</sup> [http://www.cgdev.org/doc/millions/MS\\_case\\_7.pdf](http://www.cgdev.org/doc/millions/MS_case_7.pdf)

<sup>70</sup> <http://pubs.sciepub.com/ajidm/2/2/3/> - table 3 suggests an average age of around 40-45 for both blindness and low vision, with around 10-15 years of life remaining (life expectancy is 52, but higher given that they make it to 45)

<sup>71</sup> <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2100367/table/pntd-0000114-t001/>

<sup>72</sup> There seems to be around 2.5 times as many people suffering from low vision as blind from onchocerciasis (see [http://www.cgdev.org/doc/millions/MS\\_case\\_7.pdf](http://www.cgdev.org/doc/millions/MS_case_7.pdf)), and so it seems reasonable to assume that the amount of low vision cases and blindness cases decrease at the same rate

<sup>73</sup> <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2100367/table/pntd-0000114-t001/>

<sup>74</sup> See footnote 66

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- Onchocerciasis Control Program (above): 43.4-130. However, note that at the start of the program the intervention was insecticide spray – which is likely to be less effective than ivermectin, and hence the true effectiveness of ivermectin in this program is likely higher than this estimate.
- DCP2: 40<sup>75</sup> or 7 in APOC (African Programme for Onchocerciasis Control) countries.<sup>76</sup>
- Cochrane Summary: “Four studies based in west Africa were included in the review; two small studies in Ghana and Liberia and two larger community-based ones in Nigeria and Sierra-Leone. In the smaller studies, people with onchocercal infection were given one dose of ivermectin or placebo and followed up for one year. In the larger studies all individuals in selected communities were treated every six or 12 months with ivermectin or placebo, whether or not they were infected, and followed for two to three years. This review found that ivermectin can prevent damage to the front of the eye but its effectiveness in preventing blindness remains uncertain.”<sup>77</sup>

Evidence appears to be lacking, but the evidence that exists appears sufficient to warrant further investigation.

### **2.4 (Other) Corneal Opacities**

Corneal opacities are conditions that lead to the inflammation and scarring of the cornea.<sup>78</sup> This includes trachoma and onchocerciasis, as discussed above. It causes 4% of global blindness and 1% of visual impairment.<sup>79</sup> Examples of corneal opacities are ocular trauma (cornea damage due to injuries, including from war and civil unrest) and corneal ulceration. Trauma and ulceration seem to be highly neglected in terms of academic research, and possibly also in terms of healthcare provision.

A WHO review stated “Unfortunately, antibiotic and antifungal treatment for microbial keratitis [eye infections that lead to ulceration] is relatively costly and the visual outcome is almost invariably poor. In many developing countries antifungal medications are not available at any price.”<sup>80</sup> It was, however, optimistic about the effectiveness of a preventative antibiotic (chloramphenicol), though there appears to be no cost-effectiveness research on it (perhaps because it is privately available in the developing world, so that public health bodies do not need to consider whether it is worth funding), and so cannot be considered.

### **2.5 Glaucoma**

Glaucoma is one of the most common causes of low vision, being responsible for 8% of visual impairment and 2% of blindness in 2002.<sup>81</sup> The NHS says:

“Glaucoma occurs when the drainage tubes (trabecular meshwork) within the eye become slightly blocked. This prevents eye fluid (aqueous humour) from draining properly. When the fluid cannot drain properly, pressure builds up. This is called intraocular pressure. This can damage the optic

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<sup>75</sup> <http://www.dcp-3.org/sites/default/files/dcp2/DCP50.pdf>

<sup>76</sup> <http://files.givewell.org/files/DWDA%202009/Interventions/Disease%20Control%20Priorities%20in%20Developing%20Countries-2nd%20Ed.pdf>

<sup>77</sup> <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD002219.pub2/abstract>

<sup>78</sup> <http://www.who.int/blindness/causes/priority/en/index8.html>

<sup>79</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf?ua=1>

<sup>80</sup> [http://whqlibdoc.who.int/bulletin/2001/issue3/79\(3\)214-221.pdf?ua=1](http://whqlibdoc.who.int/bulletin/2001/issue3/79(3)214-221.pdf?ua=1)

<sup>81</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf?ua=1>

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nerve (which connects the eye to the brain) and the nerve fibres from the retina (the light-sensitive nerve tissue that lines the back of the eye).<sup>82</sup>

Treatment is possible, while too little is known about prevention. Treatment involves either medication or surgery, and if left untreated glaucoma leads to irreversible blindness.

However, there do not appear to be cost-effective interventions (figures in \$/QALY or \$/DALY averted):

- Surgery: Chao (2014) found one paper with two estimates: 1495-7977 in Barbados, 1654-11530 in Ghana.<sup>83</sup> The cost-effectiveness in the US is also high, with one paper claiming a figure of 16824.<sup>84</sup>
- Medication: 14179.<sup>85</sup> A paper in Brazil also estimates it is 4 times less effective than surgery.<sup>86</sup>
- Screening: around 30,000 in the UK (based off two trials, which weren't RCTs) (2007).<sup>87</sup>

There is likely more evidence out there, but these preliminary findings suggest that it is not close to being sufficiently cost-effective, and is not worth investigating further.

### **2.6 Refractive errors and low vision**

Refractive errors “occur when the eye cannot clearly focus the images from the outside world. The result of refractive errors is blurred vision, which is sometimes so severe that it causes visual impairment.”<sup>88</sup> This includes short-sightedness, long-sightedness and astigmatism. The WHO estimates that 153 million people are visually impaired due to uncorrected refractive errors.<sup>89</sup> Treatment can involve glasses, contact lenses or visual acuity surgery (e.g. laser eye). Another possible intervention is screening, in order to get people suffering from refractive errors to a primary healthcare system, should it already be in place.

Cost-effectiveness:

- Primary eye care: Between 111 (Asia) and 672 (Europe),<sup>90</sup> 1075-5775 in India for children.<sup>91</sup>
- Screening: Between 67 (Asia) and 458 (Europe),<sup>92</sup> 221-1211 in Indian schools for children.<sup>93</sup> However, a Cochrane Summary stated: “At present there are no robust trials available that allow the benefits of school vision screening to be measured. The disadvantage of attending school with a visual acuity deficit also needs to be quantified. The impact of a screening programme will depend on the geographical and socio-economic setting in which it is conducted. There is, therefore, clearly a need for well-planned randomised controlled trials to be undertaken in various settings so that the potential benefits and harms of vision screening can be measured.”<sup>94</sup>

Screening has some promise, though it seems highly unlikely there will be a charity specifically designed to provide screening for refractive errors, at least on its own. In any case, there is too little data for it to be

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<sup>82</sup> <http://www.nhs.uk/conditions/Glaucoma/Pages/Introduction.aspx>

<sup>83</sup> <http://download.thelancet.com/pdfs/journals/langlo/PIIS2214109X1470213X.pdf>

<sup>84</sup> <http://www.ncbi.nlm.nih.gov/pubmed/22332202>

<sup>85</sup> <http://www.ncbi.nlm.nih.gov/pubmed/22332202>

<sup>86</sup> <http://www.scielo.br/pdf/abo/v75n1/02.pdf>

<sup>87</sup> <http://www.ncbi.nlm.nih.gov/pubmed/17927922>

<sup>88</sup> <http://www.who.int/features/qa/45/en/>

<sup>89</sup> <http://www.who.int/features/qa/45/en/>

<sup>90</sup> <http://www.ncbi.nlm.nih.gov/pubmed/18621429>

<sup>91</sup> <http://218.248.31.202/journal/article/J00000047.pdf>

<sup>92</sup> <http://www.ncbi.nlm.nih.gov/pubmed/18621429>

<sup>93</sup> <http://218.248.31.202/journal/article/J00000047.pdf>

<sup>94</sup> <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD005023.pub2/abstract>

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worth considering funding charities in the area at this point, and it will likely form part of future healthcare in the developing world.

### 2.7 Diabetic Retinopathy

Diabetic retinopathy occurs when consistently high blood sugar damages the retina at the back of the eye.<sup>95</sup> If this remains untreated it leads to blindness. It is responsible for around 1% of global blindness and visual impairment.<sup>96</sup> Risk factors include diabetes (and higher intensity and length of diabetes), pregnancy, nutrition and genetics.<sup>97</sup> Treatment currently involves laser coagulation, which aims to remove the lesions in the retina causing the issue, in order to slow the disease and to prevent any from becoming severe.

Prevention predominantly involves prevention of diabetes, which is extremely unlikely to be as cost-effective as our top charities. The cost-effectiveness of laser coagulation (surgery to deal with diabetic retinopathy) has been estimated at \$1996-3339/QALY,<sup>98</sup> 678,<sup>99</sup> and 3101-3655,<sup>100</sup> though these papers are from over 10 years ago and done in the US (and inflation would raise these estimates). While interventions tend to be more cost-effective in the developing world, the treatment is sufficiently complex and requires good healthcare to be sceptical that it can be done effectively in the developing world. Therefore, we do not believe diabetic retinopathy is a promising area for donors.

### 2.8 Age-related Macular Degeneration (AMD)

AMD is a condition arising from the development of degenerative lesions.<sup>101</sup> It is a significant cause of blindness, causing 5% of global blindness and 1% of visual impairment.<sup>102</sup> The major risk factor is aging, though “other risk factors may include the use of tobacco, genetic tendencies, the degree of pigmentation (with light coloured eyes being at higher risk), arterial hypertension, the ultraviolet rays, and consumption of a non-balanced diet.”<sup>103</sup>

Prevention is currently best done by reducing smoking, and there are currently no treatments. Smoking cessation programs’ cost-effectiveness has been estimated at \$1915/QALY in the US<sup>104</sup> and £221-873 per life year saved in the UK.<sup>105</sup> One based off the Seychelles estimated that it cost \$227-599 per life year saved at prices on the global market and \$1324-4597 at US prices.<sup>106</sup> This is not sufficiently cost-effective to be worth considering further, especially from the perspective of blindness.

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<sup>95</sup> <http://www.nhs.uk/conditions/diabetic-retinopathy/Pages/Introduction.aspx>

<sup>96</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf?ua=1>

<sup>97</sup> <http://www.who.int/blindness/causes/priority/en/index5.html>

<sup>98</sup> <http://journal.diabetes.org/diabetesspectrum/96v9n03/pg182.htm>

<sup>99</sup> <http://pediatrics.aappublications.org/content/104/4/e47.full>

<sup>100</sup> <http://www.ncbi.nlm.nih.gov/pubmed/10977223>

<sup>101</sup> <http://www.who.int/blindness/causes/priority/en/index7.html>

<sup>102</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf?ua=1>

<sup>103</sup> <http://www.who.int/blindness/causes/priority/en/index7.html>

<sup>104</sup> <http://jama.jamanetwork.com/article.aspx?articleid=419083>

<sup>105</sup> <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1765918/pdf/v053p000S2.pdf>

<sup>106</sup> <http://tobaccocontrol.bmj.com/content/13/2/190.short>

## 2.9 Childhood blindness

Childhood blindness is a group of conditions “occurring in childhood or early adolescence, which, if left untreated, result in blindness or severe visual impairment that are likely to be untreatable later in life”.<sup>107</sup> It is responsible for 1% of visual impairment and 4% of global blindness.<sup>108</sup> Xerophthalmia (vitamin A deficiency) is a leading cause, responsible for 350,000 cases of childhood blindness from a total of 1.5 million in 2001.<sup>109</sup> For more on vitamin A supplementation, including the cost-effectiveness of interventions to tackle it, see our [latest research](#) on micronutrients.

Another leading cause of child blindness is conjunctivitis of the newborn. This is generally caused by gonorrhoea or trachoma infections,<sup>110</sup> though some other sexually transmitted diseases can also cause childhood blindness. It is outside the scope of this report to consider the effectiveness of the prevention of sexually transmitted diseases, however one may want to look at [our research on HIV/AIDS](#) or reproductive health (forthcoming) as a guide to the types of interventions and their effectiveness.

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<sup>107</sup> <http://www.who.int/blindness/causes/priority/en/index3.html>

<sup>108</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf?ua=1>

<sup>109</sup> [http://whqlibdoc.who.int/bulletin/2001/issue3/79\(3\)214-221.pdf?ua=1](http://whqlibdoc.who.int/bulletin/2001/issue3/79(3)214-221.pdf?ua=1)

<sup>110</sup> [http://en.wikipedia.org/wiki/Neonatal\\_conjunctivitis#Cause](http://en.wikipedia.org/wiki/Neonatal_conjunctivitis#Cause)



## 3 CURRENT WORK ON BLINDNESS

### 3.1 Broad work

The World Health Organisation launched Vision 2020 in 1999 with the aim of eliminating the main causes of preventable and avoidable blindness by 2020,<sup>111</sup> with the 2014-9 action plan setting the target of “the reduction in prevalence of avoidable visual impairment by 25% by 2019”<sup>112</sup> as compared to 2010.

How much success has there been? As said earlier, the WHO’s statistics have suggested that blindness has stayed constant at around 39m, while visual impairment has been at 161m in 2002<sup>113</sup> and 162.7m in 2010,<sup>114</sup> excluding uncorrected refractive errors. However, population has grown over this time, particularly amongst those over 50. For example, between 1990 and 2002 global population grew 18.5% while population of those over 50 grew nearly 30%.<sup>115</sup> As age is a significant risk factor for blindness and visual impairment, blindness rates should grow even quicker than the population growth, yet remain roughly stable. The WHO attributed this to two major factors:

- “- More data from population based studies on visual impairment carried out over the last decade are available allowing for more accurate estimates to be made.
- Significant achievements have been made in the prevention and management of avoidable blindness along the lines of the "VISION 2020: The Right to Sight" priorities.

These include:

- Increased public awareness and utilization of eye health care services.
- Increased availability and affordability of eye health care services.
- Increased global political commitment to prevention of visual impairment.
- Increased professional commitment to prevention of visual impairment.
- Commitment and support of non-governmental organizations.
- Involvement and partnership with the corporate sector.
- More effective primary eye care activities as an integral part of the primary health care system which have contributed to the decline in vision loss from trachoma, onchocerciasis, vitamin A deficiency and even from cataract through better services including outreach case finding and eye health education.
- Impressive successes with elimination of blindness efforts in the Gambia, India, Morocco, Nepal, Sri Lanka, Thailand, and other countries.”<sup>116</sup>

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<sup>111</sup> <http://www.who.int/blindness/partnerships/vision2020/en/>

<sup>112</sup> [http://www.who.int/blindness/AP2014\\_19\\_English.pdf?ua=1](http://www.who.int/blindness/AP2014_19_English.pdf?ua=1)

<sup>113</sup> [http://whqlibdoc.who.int/bulletin/2004/Vol82-No11/bulletin\\_2004\\_82\(11\)\\_844-851.pdf?ua=1](http://whqlibdoc.who.int/bulletin/2004/Vol82-No11/bulletin_2004_82(11)_844-851.pdf?ua=1)

<sup>114</sup> <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf> - 285.4m visually impaired, 43% due to refractive errors,  $285.4 * (1 - 0.43) = 162.7$

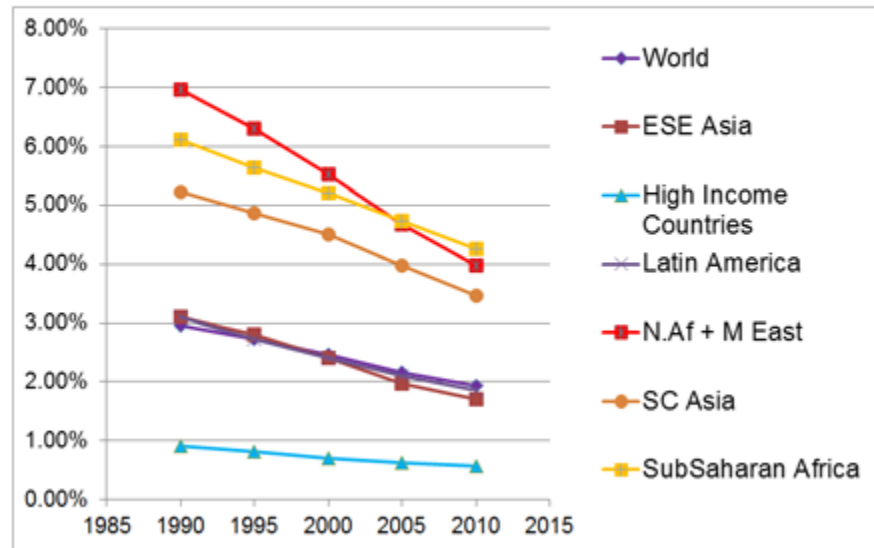
<sup>115</sup> <http://www.who.int/blindness/causes/trends/en/>

<sup>116</sup> <http://www.who.int/blindness/causes/trends/en/>

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With rising population and constant blindness rates, the percentage of people suffering from blindness and visual impairment is decreasing:

**Fig 2 The change in age standardised prevalence rates of blindness for population aged 50 years and older over time for the world and for regions.**



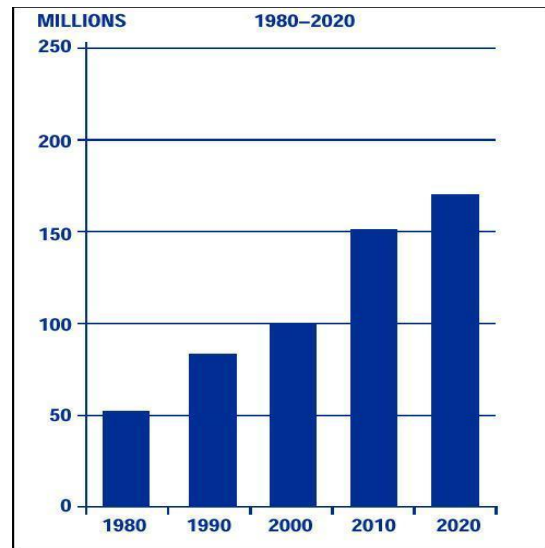
If the percentage of people suffering from blindness continues to decrease linearly, as the above graph suggests, one would expect the total amount of people blind to decrease in absolute terms.<sup>117</sup> While this is unlikely to happen, since much of the current work is curing the cheapest avoidable blindness and cannot be done indefinitely, it means that the current constancy of blindness and visual impairment figures is misleading – there is a substantial amount of work being done.

<sup>117</sup> As the prevalence rates of blindness falls linearly, each change is a bigger proportion of the total blindness. For example, a decrease in the prevalence rates from 10% to 9% is a 10% decrease, while an identical 1% fall from 2% to 1% is a 50% decrease. As time goes by, eventually this percentage decrease will exceed the population increase percentage. Given that the amount of people blind has stayed roughly constant in the past, and that the linear decrease becomes a bigger proportion over time, this suggests the total amount will decrease soon, and quite rapidly after that. Indeed, this is what appears to be happening, if PwC's estimate (on page 1 of this report) of the total amount of blindness is correct.

### 3.2 Cataract

As mentioned before, risk factors for cataract include aging, smoking, UV light, and diabetes. None of these factors are significantly decreasing (while life expectancy goes up and diabetes is rising), which leads us to expect the amount of cases of cataract will increase. Indeed, a paper in 2000 predicted a significant increase:

Surgeries, however, can significantly reduce the burden of cataract, and so the issue is whether cataract surgery provision will expand to cater for the number of cases anyway, or whether additional donor resources will make an irreplaceable difference. But there are significant barriers: cataract surgeries are expensive for those in poverty, people fear the surgery, surgery is not always successful, and there is a shortage of eye surgeons.<sup>118</sup>



As such, charities are not likely to be able to fund cataract surgeries alone, without training eye surgeons. Indeed, as shown later, the charities we found all train health workers in some capacity. Even this is not enough to guarantee people will attend, because of fear of surgery and imperfect results. But with the extra interventions that have to be done, such as free transport, a charity will struggle to meet the optimistic \$/DALY figures mentioned earlier.

India's Cataract Blindness Control Program does provide encouragement that, even with all of these issues, it can be done cost-effectively. However, it doesn't necessarily say much about the effect of a charity trying to do similar work. Would the CBCP have been successful on a smaller level, like that done by charities? Is it cost-effective to set up new health centres devoted to cataract cases, or is it better to improve existing ones? It's difficult to see how to begin to answer these questions. A best guess is that it will be hard for charities to challenge the effectiveness of a government commitment to country-wide coverage of cataract, because of the other factors at play.

One can compare cataract to the likes of deworming: we have an intervention that is roughly as cost-effective, except that it requires more training (requires eye surgeons, as opposed to training school teachers to collect data), assistance (from health providers), education (to dispel fears), is more expensive (\$10/surgery rather than \$0.50 per tablet, and likely involves paying eye surgeons, unlike with teachers) and less easy to mass distribute (surgeries versus mass handouts in schools). On the other side, one could argue that the cost is one off (you do surgery once, rather than yearly deworming), may have a bigger effect on productivity, and requires fewer people to train (lots of teachers rather than a few eye surgeons).

For these reasons, we cannot be confident that the effectiveness of charities treating cataract are as cost-effective as our top charities. However, it does seem likely that work being done in the area is highly effective. Discussion of cataract charities will follow later, when it will be discussed alongside trachoma and onchocerciasis charities.

<sup>118</sup> <http://www.iapb.org/vision-2020/what-is-avoidable-blindness/cataract>

### 3.3 Trachoma

A 2012 WHO article on the situation of trachoma paints a positive picture. **From the 53 countries that are endemic in blinding trachoma:**

- 28 reported data on implementing the SAFE strategy.
- 6 countries reported that trachoma was no longer a public health problem in 2012 (<0.1% suffer from trichiasis, <5% of 1-9 year olds suffer from active trachoma).
- The number of people living in trachoma endemic districts reduced from 317m in 2010 to 241m in 2012 – almost a 25% decrease in just two years.
- 48.8 million people received antibiotics.
- 169,000 trachoma surgeries were carried out.<sup>119</sup>

A 2006 estimate also stated that the number of people affected by trichiasis fell from 360m in 1985 to just 80m in 2006.<sup>120</sup>

If 6 countries per year continue to eliminate trachoma as a public health problem, trachoma would be endemic nowhere in 9 years; if the number of people living in endemic districts continues to decrease by 76m per two years, the figure would be 0 in just 7 years. It will inevitably be more difficult to eliminate the last few cases, and the countries that are late to eliminate it may have particular difficulties doing so, which may be why they have not dealt with trachoma already. Nevertheless, this gives reason to be optimistic about the prospect of eradication.

Because of the prospect of eradication, the WHO called for the eradication of trachoma as a public health problem by 2020, and leads the Alliance for Global Elimination of Trachoma by the year 2020 (GET 2020).<sup>121</sup> In response, the International Trachoma Initiative (ITI) was founded in 1998, which co-ordinates the distribution of antibiotics, partners with governments to implement the SAFE strategy, and to collect data on trachoma.<sup>122</sup> The International Coalition for Trachoma Control also helps to oversee work being done on trachoma, to encourage collaboration and greater support for eradication.<sup>123</sup>

Considering the amount of work already being done in the area, with extremely impressive results, one must question whether there is room for more funding. That said, ITI and WHO do have many partners which work on reducing trachoma, and that there are such partners suggests there is a gap for charities. The question remains, though, whether donating to a charity means irreplaceable work: if one charity can't fund part of the SAFE program, organisers may choose a different partner which is roughly as good, rather than none at all.

When one combines concerns about the effectiveness of surgery, the combined effectiveness of SAFE, the role of charities in what seems to be a WHO and government-dominated area, and the possible replaceability of donations, it seems unlikely that trachoma charities will challenge our top recommended ones. However, the work being done is likely to be effective and will contribute to a reduction, and possible elimination, in trachoma.

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<sup>119</sup> [http://www.who.int/gho/neglected\\_diseases/trachoma/en/](http://www.who.int/gho/neglected_diseases/trachoma/en/)

<sup>120</sup> <http://www.who.int/mediacentre/news/notes/2006/np09/en/>

<sup>121</sup> <http://www.who.int/blindness/causes/trachoma/en/>

<sup>122</sup> <http://trachoma.org/how-iti-works>

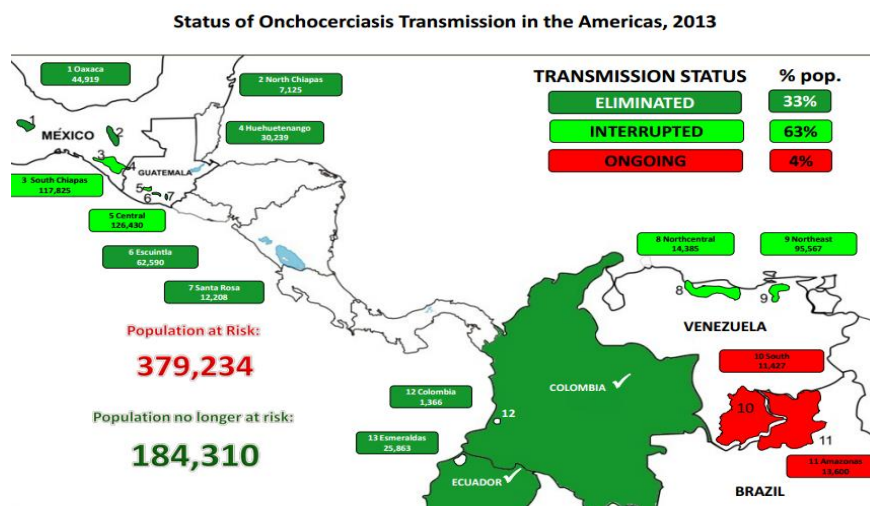
<sup>123</sup> <http://www.trachomacoalition.org/about-us/aims-and-objectives>

### 3.4 Onchocerciasis

Currently, there are 31 countries endemic with onchocerciasis, along with several foci (key areas) in Latin America.<sup>124</sup> The Onchocerciasis Control Program, in operation in West Africa between 1974 and 2002, near eliminated onchocerciasis from 10 of 11 countries they worked in, with the exception being civil war-ridden Sierra Leone, which led to the program's closure in 2002.<sup>125</sup>

There are two active programs helping to eliminate onchocerciasis in the remaining endemic areas. One is OEPA – the Onchocerciasis Elimination Program of the Americas. It began in 1992, working in 6 countries with 13 key areas, of which 11 had interrupted transmission by 2013.<sup>126</sup> The other 3 had also achieved greater than 85% coverage, suggesting they too may soon eliminate it.<sup>127</sup> The Carter Center, the leader of the OEPA, stated:

“Today, as the result of highly successful national programs, this once 'neglected' tropical disease has been wiped from 96 percent of the region and no one need fear becoming blind from river blindness in the Americas.”<sup>128</sup>



The other program currently ongoing is the African Program for Onchocerciasis Control (APOC), which works in the endemic African countries that were not part of the OCP (plus four endemic ex-OCP countries). It uses health workers to train volunteers, so that those volunteers can carry out the distribution of ivermectin, create censuses, keep records, etc.<sup>129</sup> APOC will end in 2015, to be replaced by a

new body which focusses on neglected tropical diseases as a whole, and aims to transfer responsibility of onchocerciasis control to ministries of health.<sup>130</sup> As such, there is no room for charities here, although several NGOs and local NGOs are incorporated into the plan.<sup>131</sup> Onchocerciasis is already under control, with all endemic regions being part of either APOC or OEPA. The prospect of eradication is exciting, with an estimated 9.8 million DALYs averted by 2011 from the project,<sup>132</sup> but likely not one which a donor can do much to get involved with.

<sup>124</sup> <http://www.who.int/mediacentre/factsheets/fs374/en/>  
<sup>125</sup> [http://www.who.int/blindness/partnerships/onchocerciasis\\_OCP/en/](http://www.who.int/blindness/partnerships/onchocerciasis_OCP/en/)  
<sup>126</sup> [http://www.cartercenter.org/health/river\\_blindness/oeпа.html](http://www.cartercenter.org/health/river_blindness/oeпа.html)  
<sup>127</sup> <http://www.who.int/mediacentre/factsheets/fs374/en/>  
<sup>128</sup> [http://www.cartercenter.org/health/river\\_blindness/oeпа.html](http://www.cartercenter.org/health/river_blindness/oeпа.html)  
<sup>129</sup> <http://www.who.int/apoc/cdti/howitworks/en/>  
<sup>130</sup> <http://www.who.int/apoc/sustainability/en/>  
<sup>131</sup> <http://www.who.int/apoc/about/en/>  
<sup>132</sup> <http://www.who.int/apoc/about/en/>

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### 3.5 Charities

The charities investigated are ones which are partners of the WHO or International Trachoma Initiative, and which are working in the developing world on cataract, trachoma or onchocerciasis (and not working on a range of other causes that seem less effective). There are likely some more, though the ones below likely include most of the major charities.

The Fred Hollows Foundation (FHF) aims to eliminate avoidable blindness, while also improving the quality of life of indigenous Australians.<sup>133</sup> It works in 19 countries with an income of A\$58m in 2013.<sup>134</sup> GiveWell also evaluated the charity in 2010, deciding not to choose it as one of their top recommended charities.<sup>135</sup>

Helen Keller International (HKI)'s mission "is to save the sight and lives of the most vulnerable and disadvantaged. We combat the causes and consequences of blindness and malnutrition by establishing programs based on evidence and research in vision, health and nutrition."<sup>136</sup> Similarly to FHF, the charity is large, working in 22 countries with individual and corporate donations totalling \$20.5m in 2013, and \$137m in total operational support.<sup>137</sup>

Orbis aims to tackle blindness with a combination of advocacy, training and research.<sup>138</sup> They advocate for increased health expenditure on blindness, trains health teams and supports research "to develop strategy for evidence based interventions to plan the design and development of our programs".<sup>139</sup> Revenue totalled \$149m in 2013.<sup>140</sup>

Sightsavers' vision "is of a world where no one is blind from avoidable causes and where visually impaired people participate equally in society."<sup>141</sup> They work on all causes of preventable blindness, and also has programmes to increase education, community involvement and social inclusion for those blind. Income was £38.8m in 2012.<sup>142</sup>

Below are the charities, and the interventions they implement:

	<u>FHF</u>	<u>HKI</u>	<u>Orbis</u>	<u>SightSavers</u>
<u>Blindness interventions</u>				
<b>Cataract Surgery</b>	Yes (A\$25)	Unclear <sup>143</sup>	No	Yes (£50 <sup>144</sup> )

<sup>133</sup> <http://www.hollows.org.au/about-us/achievements>

<sup>134</sup> [http://www.hollows.org.au/sites/default/files/pdfs/annualreports/FHF2013\\_Annual\\_Report.pdf](http://www.hollows.org.au/sites/default/files/pdfs/annualreports/FHF2013_Annual_Report.pdf)

<sup>135</sup> <http://www.givewell.org/international/charities/Fred-Hollows-Foundation>

<sup>136</sup> <http://www.hki.org/about-us/>

<sup>137</sup> [http://www.hki.org/file/resource/HKI\\_Annual\\_Report\\_2013-FINAL\\_compressed.pdf](http://www.hki.org/file/resource/HKI_Annual_Report_2013-FINAL_compressed.pdf)

<sup>138</sup> <http://www.orbis.org/pages/how-we-work>

<sup>139</sup> <http://www.orbis.org/pages/research>

<sup>140</sup> <http://campaigns.orbis.org/2014annualreport/>

<sup>141</sup> [http://www.sightsavers.net/about\\_us/publications/19825\\_Sightsavers%20Annual%20Review%202012.pdf](http://www.sightsavers.net/about_us/publications/19825_Sightsavers%20Annual%20Review%202012.pdf)

<sup>142</sup> [http://www.sightsavers.net/about\\_us/publications/19825\\_Sightsavers%20Annual%20Review%202012.pdf](http://www.sightsavers.net/about_us/publications/19825_Sightsavers%20Annual%20Review%202012.pdf)

<sup>143</sup> Their focus appears to be assisting ongoing cataract surgery: "Working in partnership with local Ministries of Health, Helen Keller International works to improve the accessibility, efficiency and quality of cataract treatment and surgical care." However, their donation page mentions cataract surgery (at a cost of \$50/surgery), so they may fund some/all of the cataract treatments of their partners

<sup>144</sup> <https://donate.sightsavers.org/smxpatron/uk/donate.html>

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<b>Trachoma: S, SAFE, other?</b>	S & A	SAFE (S: \$40-60)	No	SAFE (S: £8! <sup>145</sup> )
<b>Mapped trachoma prevalence</b>	Yes	No?	Yes	Yes
<b>Onchocerciasis drug distribution</b>	No	Yes	No	Yes
Diabetic Retinopathy surgery	Yes	Some	No	Yes
Glaucoma treatment	No	No	No	Yes
Screening	Yes	Yes (mainly USA)	No	Yes
Provide glasses	Yes	Refer	No	Yes
<b>Vitamin A supplementation</b>	No	Yes	No	Yes
Building hospitals	Yes	No	No	No
Mobile hospitals <sup>146</sup>	Yes	No	Yes <sup>147</sup>	Yes
Advertise available eye services / outreach activities	Yes	Yes	No	No
<i>Supply medical equipment</i>	Yes	Yes	Likely not	Maybe
<i>Train medical staff<sup>148</sup></i>	Yes	Yes	Yes	Yes

The interventions marked in bold are ones we believe to be highly cost-effective. Note that vitamin A supplementation is also cost-effective, as our research on micronutrients has shown.<sup>149</sup> However, there are some interventions which it is difficult to see how we can evaluate the effectiveness. Supplying medical equipment and training medical staff, if they wouldn't have otherwise been provided or trained, is potentially very important and cost-effective. This is a key focus of Orbis, and thus it is difficult to know how cost-effective Orbis is with sufficient confidence to recommend them, though their apparent commitment to effectiveness, at least in research, is encouraging.

The other charities work on a broad range of interventions, some of which are effective, some of which are less effective (such as diabetic retinopathy surgery, glaucoma treatment, screening, provision of glasses). Because of this, the effectiveness of the charity as a whole depends on how much of their funding goes to effective interventions.

<sup>145</sup> <https://donate.sightsavers.org/smxpatron/uk/donate.html> – this seems unlikely, and as a result of this likely underestimate they may underestimate the cost of cataract surgery too

<sup>146</sup> These travel around into hard to reach communities

<sup>147</sup> They have a 'flying eye hospital' – one on a plane, which aims to be transportable, rather than reach hard to get areas

<sup>148</sup> Ophthalmologists, surgeons, nurses, clinic support staff or community health workers

<sup>149</sup> <http://www.givingwhatwecan.org/research/charities-area/micronutrients>

## **Giving What We Can Blindness report 2014**

### 3.5.1 Fred Hollows Foundation

According to the Fred Hollows Foundations's annual report, in 2013 the organisation and partners achieved:

- 123,193 cataract surgeries and 326,575 other eye operations and treatments
- 4,101,841 people treated with antibiotics to combat trachoma
- 4,427 diabetic retinopathy procedures
- 2,862,514 eye screenings
- 221 surgeons and 41,968 eye health workers trained
- 48 medical facilities built or upgraded
- \$3,572,104 in medical equipment supplied<sup>150</sup>

If we take FHF's advertised figure of \$25, and (generously) assume that all eye operations and treatments are of the same effectiveness and cost as cataract surgeries, then a total of A\$11.2m was spent on highly effective interventions. The last 3 bullet points may also be effective, though it is difficult to be sure. This means that, being optimistic, around A\$20-30m was spent on effective interventions, out of a total of A\$41.5m on program expenses. A pessimistic figure could reasonably be put around A\$5-10m of effective spending – A\$3m for cataract surgeries, and another few million to take into account the other interventions are (probably) still effective.

From this, it seems that it is around 2-5 times less effective as it would be if it exclusively performed cataract surgeries, i.e. that the \$/DALY figure of FHF is around 180-450 (taking cataract surgery at \$90/DALY). This isn't sufficiently effective to recommend, and there are inevitably reasons to be more pessimistic: would some surgeries be performed without FHF's help? Can they do it as effectively as academic papers suggest? Is the advertised figure of A\$25 per surgery really accurate?

### 3.5.2 Helen Keller International

According to their annual report, HKI spent the following on each of their programs in 2013 (in USD):

- ChildSight® 1,352,784 [ChilDSight is a program to provide glasses, predominantly for those living in poverty in the US]
- **Trachoma** 1,121,390
- Famine and Other Relief Services 3,016,657
- **Nutrition, including Vitamin A** 28,089,535
- **Onchocerciasis** 66,178
- *Eye Health* 1,259,469
- **Neglected Tropical Diseases** 10,150,318
- Distribution of medicines and other (in-kind), primarily for blindness prevention 77,841,354<sup>151</sup>

In 2013, HKI received \$77,876,062 of in-kind medical supplies and medicine – very close to the figure for the distribution of in-kind medicines. As a result, it seems likely that additional donations will go towards the other programs. A significant proportion of other expenditure seems to be spent very effectively – a combination of effective interventions. The focus is on nutrition, which it is outside the scope of the report to consider, but seems promising. As such, HKI should be investigated further, though predominantly from the perspective of nutrition.

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<sup>150</sup> [http://www.hollows.org.au/sites/default/files/pdfs/annualreports/FHFAU\\_2013\\_Annual\\_Report.pdf](http://www.hollows.org.au/sites/default/files/pdfs/annualreports/FHFAU_2013_Annual_Report.pdf)

<sup>151</sup> [http://www.hki.org/file/resource/HKI\\_Annual\\_Report\\_2013-FINAL\\_compressed.pdf](http://www.hki.org/file/resource/HKI_Annual_Report_2013-FINAL_compressed.pdf)



## **Giving What We Can Blindness report 2014**

### 3.5.3 SightSavers

According to their annual report, SightSavers' 2012 £29.3m program expenses were distributed as follows:

- *Eye health* £20.94m
- **Mectizan** £1.038m [onchocerciasis drug]
- Education £2.847m
- Social inclusion £3.273m
- Policy research £1.198m<sup>152</sup>

Mectizan distribution is highly effective, as are certain areas of eye health. In terms of eye health, in 2012 SightSavers:

- "Directly supported" 284,332 operations
- Trained 45 eye surgeons, 230 allied health workers, and 220,000 village level volunteers
- Treated 12.5m people with trachoma antibiotics
- Performed 20,500 trachoma surgeries

Unfortunately, they do not publically provide data on the amount spent on areas within eye health.<sup>153</sup> On their page on cataract, they put screening above provision of surgery, suggesting surgery is not their focus.<sup>154</sup> In their financial reports, under surgery they specified the causes of blindness in brackets – "cataract, glaucoma, diabetic retinopathy, trichiasis in that order – suggesting that their focus is not on the most effective causes. We have emailed them to find out more but have not currently received a response.

### 3.5.4 Comparing charities

The charity that seems most effective, from the above, is Helen Keller International because of the high proportion spent on effective programs. However, to be sure of this, one needs to have researched nutrition in greater depth. SightSavers' lack of transparency on the distribution of expenditure on eye care is surprising given the amount of other financial information they provide, but it seems likely that a significant proportion will not be to effective interventions. The Fred Hollows Foundation similarly seems to spend a significant proportion on less effective interventions. Finally, Orbis seems to be a well-run organisation but without any way of estimating their effectiveness, we cannot recommend them.

However, one could try to earmark donations so that even if a charity spends money on less effective programs, one could still, on the margin, give only to effective interventions. We have emailed FHF, HKI and SightSavers and have not yet received a response. We also asked if donations are fungible, i.e. whether money nominally given to cataract surgeries would really do so.

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<sup>152</sup> [http://www.sightsavers.net/about\\_us/publications/19825\\_Sightsavers%20Annual%20Review%202012.pdf](http://www.sightsavers.net/about_us/publications/19825_Sightsavers%20Annual%20Review%202012.pdf)

<sup>153</sup> Searched through 2012 financial statements -

[http://www.sightsavers.net/about\\_us/governance/annual%20review/19864\\_SSFinReport2012PLoRes.pdf](http://www.sightsavers.net/about_us/governance/annual%20review/19864_SSFinReport2012PLoRes.pdf)

<sup>154</sup> [http://www.sightsavers.net/our\\_work/how\\_we\\_help/health/causes\\_of\\_blindness/cataract/16930.html](http://www.sightsavers.net/our_work/how_we_help/health/causes_of_blindness/cataract/16930.html)

## **4 CONCLUSION**

Blindness and visual impairment are significant issues worldwide. There are many causes, of which we believe three have effective interventions. Trachoma and onchocerciasis are two of these, and are neglected tropical diseases; neglected tropical disease is an area where we have found many promising charities in the past, including two currently recommended charities. Because of their significant promise, they are well on their way to eradication, which means it is unlikely that a donor can do significant good at this stage of the process.

Cataract also has an effective intervention, and is predominantly associated with aging and thus will become a bigger issue globally as life expectancy increases. Although surgery is promising, there are many limiting factors, such as a lack of eye surgeons, which make it difficult to realise the potential cost-effectiveness of cataract surgery. The solution to this likely involves governments investing into improving primary health care to include eye care, and may not be one in which a donor's money can translate smoothly into more surgery. The World Health Organisation works to incorporate eye care into governmental health care, and thus there is probably limited potential to lobby governments to speed up the process.

As such, while blindness is a promising area, donors should look elsewhere to have confidence in finding effective donation targets. It will be worth re-evaluating in a few years whether more can be done by charities to increase cataract surgery provision, and whether trachoma and onchocerciasis continue moving towards eradication. For now, if one wants to give to blindness, there are several charities to choose from which work on a number of causes of blindness, albeit their diversification may negatively impact effectiveness. We think Helen Keller International is a good bet, because a significant proportion of their expenditure appears to be spent effectively, though they spend significant amounts on nutrition, which is likely effective but outside of the scope of this report to look into further. Should one want to give to a solely blindness focussed charity, the Fred Hollows Foundation or SightSavers are both reasonable choices, though significant proportions of their money seems to be spent on less effective interventions.