A Manual for VISION 2020: The Right to Sight Workshops
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What Do We Know About Blindness?
Questions about Blindness

There are 4 important questions to be asked when considering prevention of blindness; these are:

- **What is blindness?** - DEFINITION
- **How many people are blind?** - MAGNITUDE
- **Why are people blind?** - AETIOLOGY
- **What can be done to reduce blindness?** - CONTROL

**Question 1. What is blindness and visual impairment?**

The World Health Organisation has classified visual impairment and blindness into various grades. These are as follows:

<table>
<thead>
<tr>
<th>VISUAL ACUITY IN BETTER EYE</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>6/6</td>
<td>6/18</td>
</tr>
<tr>
<td>&lt;6/18</td>
<td>6/60</td>
</tr>
<tr>
<td>&lt;6/60</td>
<td>3/60</td>
</tr>
<tr>
<td>&lt;3/60</td>
<td>N.P.L.</td>
</tr>
</tbody>
</table>

Note that:
- All visions are the better eye
- All visions are with available correction
- Less than 10 degrees central field is equivalent to “blindness”
- <6/18 to 3/60 is sometimes called Low Vision

**Exercise 1**

**Categorise these people according to their visual acuity**

<table>
<thead>
<tr>
<th></th>
<th>VISION RE</th>
<th>VISION LE</th>
<th>CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6/18</td>
<td>2/60</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>P.L.</td>
<td>1/60</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6/60</td>
<td>6/60</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>NPL</td>
<td>3/60</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6/24</td>
<td>4/60</td>
<td></td>
</tr>
</tbody>
</table>
Question 2. How many people are blind?
In the year 2002, the estimated numbers of people who were blind, severely visually impaired, and visually impaired were -

<table>
<thead>
<tr>
<th>CATEGORY OF VISION</th>
<th>NUMBER</th>
<th>VISUAL ACUITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind</td>
<td>37 million people</td>
<td>&lt; 3/60</td>
</tr>
<tr>
<td>Low Vision</td>
<td>124 million people</td>
<td>&lt;6/18-3/60</td>
</tr>
<tr>
<td>Normal</td>
<td>6052 million people</td>
<td>6/6-6/18</td>
</tr>
<tr>
<td><strong>Total global population</strong></td>
<td><strong>6 213 million people total</strong></td>
<td></td>
</tr>
</tbody>
</table>

In the year 2002, the estimated number of blind people (prevalence) per WHO region was:-

<table>
<thead>
<tr>
<th>REGION</th>
<th>APPROX. POPULATION (mill)</th>
<th>APPROX. NO. OF LOW VISION (mill.)</th>
<th>APPROX. NO. OF BLIND PERSONS (mill.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>672</td>
<td>20</td>
<td>6.8</td>
</tr>
<tr>
<td>Americas</td>
<td>853</td>
<td>13</td>
<td>2.4</td>
</tr>
<tr>
<td>Eastern Med.</td>
<td>503</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Europe</td>
<td>878</td>
<td>13</td>
<td>2.7</td>
</tr>
<tr>
<td>S.E. Asia</td>
<td>1590</td>
<td>34</td>
<td>11.6</td>
</tr>
<tr>
<td>W. Pacific</td>
<td>1717</td>
<td>32</td>
<td>9.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6213</strong></td>
<td><strong>124</strong></td>
<td><strong>36.8</strong></td>
</tr>
</tbody>
</table>

In the year 2002, the estimated number of blind people by age group was:-

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>POPULATION (millions)</th>
<th>NO. BLIND (millions)</th>
<th>PREVALENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 14</td>
<td>2,000</td>
<td>1.37</td>
<td>0.03-0.12/100</td>
</tr>
<tr>
<td>15 – 49</td>
<td>2,600</td>
<td>5.18</td>
<td>0.1-0.2/100</td>
</tr>
<tr>
<td>49+</td>
<td>800</td>
<td>30.31</td>
<td>0.4-9.0/100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6213</strong></td>
<td><strong>37</strong></td>
<td><strong>0.6/100</strong></td>
</tr>
</tbody>
</table>
The prevalence of blindness in different countries and in different regions correlates closely with the economy and level of health care:

<table>
<thead>
<tr>
<th>ECONOMY / HEALTH CARE</th>
<th>% BLIND</th>
<th>NUMBER BLIND PER MILLION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>0.1-0.29</td>
<td>2 500</td>
</tr>
<tr>
<td>OK</td>
<td>0.3-0.59</td>
<td>5 000</td>
</tr>
<tr>
<td>Poor</td>
<td>0.6-0.79</td>
<td>7 000</td>
</tr>
<tr>
<td>Very Poor</td>
<td>0.8 and above</td>
<td>9,000+</td>
</tr>
</tbody>
</table>

The number of blind people in the world was increasing year by year. Recent data suggests that VISION 2020 activities may be having an impact.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PROJECTED NUMBER BLIND</th>
<th>ACTUAL NUMBER BLIND</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>30 million</td>
<td>30 million</td>
</tr>
<tr>
<td>1990</td>
<td>38 million</td>
<td>38 million</td>
</tr>
<tr>
<td>2000</td>
<td>50 million</td>
<td>-</td>
</tr>
<tr>
<td>2010</td>
<td>60 million</td>
<td>37 million</td>
</tr>
<tr>
<td>2020</td>
<td>75 million</td>
<td>-</td>
</tr>
</tbody>
</table>

The cause lies in part in ageing:

**Ageing Population (over 60 Years): Trends to the Year 2020**

Global Population
over 60 years old
(milliseconds)
Exercise 2
Why do you think the number of blind people is increasing?

1. ……………………………………………………………………………………………

2. ……………………………………………………………………………………………

3. ……………………………………………………………………………………………

Exercise 3
Why do you think there is more blindness in poor areas of the world?

1. ……………………………………………………………………………………………

2. ……………………………………………………………………………………………

3. ……………………………………………………………………………………………

4. ……………………………………………………………………………………………

Exercise 4
a) Indonesia has 210 million people and a blindness prevalence of 1.5%.
   How many people are blind?
   ……………………………………………………………………………………………

b) In a population based survey of 8000 people,
   64 people were found to be blind.
   What is the prevalence of blindness?
   ……………………………………………………………………………………………

c) List the major demographic “risk factors” for blindness.

1. ……………………………………………………………………………………………

2. ……………………………………………………………………………………………

3. ……………………………………………………………………………………………

4. ……………………………………………………………………………………………
Question 3. Why are people blind?
The causes vary in different countries and regions, depending on their economies and levels of health care -

The major causes of blindness in Africa are cataract, trachoma, corneal disease, glaucoma, onchocerciasis and vitamin A deficiency.

In Asia the major causes are cataract, corneal scar, glaucoma and retinal diseases.

In Latin America and Eastern Europe the major causes are cataract, glaucoma and diabetic retinopathy.

In North America and Western Europe the major causes are senile macular degeneration, diabetic retinopathy and glaucoma.

<table>
<thead>
<tr>
<th>REGION</th>
<th>APPROX. NO. OF BLIND PERSONS (millions)</th>
<th>MAJOR CAUSES OF BLINDNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>6.8</td>
<td>Cataract, Glaucoma Corneal Scar</td>
</tr>
<tr>
<td>Americas</td>
<td>2.4</td>
<td>Cataract, Glaucoma Retinal disease</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>4</td>
<td>Cataract, Glaucoma Corneal Scar</td>
</tr>
<tr>
<td>Europe</td>
<td>2.7</td>
<td>Cataract, Glaucoma Retinal disease</td>
</tr>
<tr>
<td>South East Asia</td>
<td>11.6</td>
<td>Cataract, Glaucoma Corneal scar</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>9.3</td>
<td>Cataract, Glaucoma Retinal disease</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36.8</strong></td>
<td></td>
</tr>
</tbody>
</table>

2002 Estimates

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>BLIND (millions)</th>
<th>%</th>
<th>TREND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td>17.6</td>
<td>48</td>
<td>?Increasing</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>4.5</td>
<td>12</td>
<td>Increasing</td>
</tr>
<tr>
<td>Trachoma/Scar</td>
<td>3.2</td>
<td>9</td>
<td>Decreasing</td>
</tr>
<tr>
<td>Child Blindness</td>
<td>1.4</td>
<td>4</td>
<td>Stable</td>
</tr>
<tr>
<td>Onchocerciasis</td>
<td>0.3</td>
<td>&lt;1</td>
<td>Decreasing</td>
</tr>
<tr>
<td>Diabetic Retinopathy</td>
<td>1.8</td>
<td>5</td>
<td>Increasing</td>
</tr>
<tr>
<td>ARMD</td>
<td>3.2</td>
<td>9</td>
<td>Increasing</td>
</tr>
<tr>
<td>Others</td>
<td>4.8</td>
<td>13</td>
<td>Stable</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>36.8</strong></td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>
Exercise 5
IN A HEALTH REGION OF 1,000,000 PEOPLE –

The prevalence of blindness is 1%
Cataract is responsible for 50% of blindness
Glaucoma is responsible for 10% of blindness
Childhood Blindness is responsible for 2% of blindness

How many people are blind due to cataract? .........................................
How many people are blind due to glaucoma? .................................
How many children are blind? ............................................................... Exercise 6
Complete the boxes for YOUR situation

Magnitude of blindness

<table>
<thead>
<tr>
<th>COUNTRY/ PLACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>POPULATION</td>
</tr>
<tr>
<td>PREVALENCE OF BLINDNESS</td>
</tr>
<tr>
<td>NUMBER OF BLIND (TOTAL)</td>
</tr>
</tbody>
</table>
### Causes of Blindness

<table>
<thead>
<tr>
<th>Cause</th>
<th>% All Blindness</th>
<th>Number Blind</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Question 4. What can be done to reduce blindness?

Having defined blindness, estimated the size of the problem and understood the major causes, the next step is to consider what can be done to control the problem. This will be discussed under the following headings:

Dilemmas between ophthalmology and eye care
Terminologies in the prevention of blindness
VISION 2020 for eye care programmes

DILEMMAS - OPHTHALMOLOGY OR EYE CARE SERVICES

There are certain dilemmas in decision-making to consider:

1. **A Profit OR Service Approach.**
   Modern medical care is rapidly becoming a business with the purpose of making a profit. Prevention of blindness involves a service approach, often to people in rural and poor areas, for which good financial management and resources (subsidies) are required to assist poor patients.

2. **The Practice of Ophthalmology OR Comprehensive Eye Care.**
   There is a difference between the practice of ophthalmology in a clinic and the provision of eye care at all levels of health care delivery. Eye care will include health education and prevention of diseases such as vitamin A deficiency and trachoma.

3. **An Individual OR Community Approach.**
   Clinical medicine is targeted at the care of the individual. Prevention of blindness involves assessment, planning, and delivery of services for communities as well as individuals.

TERMINOLOGIES

1. **Primary Prevention**
   Prevent the disease ever occurring, for example:
   - Vitamin A deficiency: correct nutrition
   - Trachoma: clean water and good sanitation
   - Rubella and measles: immunisation

2. **Secondary Prevention**
   Prevent loss of vision from established disease, for example:
   - Cataract: surgery when vision is down but better than < 3/60
   - Glaucoma: sight preservation; surgical or medical treatment
   - Diabetic retinopathy: sight preserving laser treatment
   - Vitamin A deficiency: if keratomalacia, saving the sight of the other eye
   - Onchocerciasis: treatment with ivermectin

3. **Tertiary Prevention**
   Restore vision to a blind patient, for example:
   - Cataract: surgery when vision is <3/60
   - Corneal scarring: keratoplasty
   - Low vision: low vision aids
Exercise 7
Complete the table

<table>
<thead>
<tr>
<th>Disease</th>
<th>Primary Prevention</th>
<th>Secondary Prevention</th>
<th>Tertiary Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glaucoma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic Retinopathy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachoma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onchocerciasis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A Deficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refractive Errors</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Blinding Eye Diseases

<table>
<thead>
<tr>
<th>Cataract</th>
<th>Trachoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glaucoma</td>
<td>Onchoceriasis</td>
</tr>
<tr>
<td>Diabetic Retinopathy</td>
<td>Vitamin A Deficiency</td>
</tr>
</tbody>
</table>

Occur Everywhere | Focal Diseases
Affect Individuals | Affect Communities
Affect Mainly Adults | Start In Children
Require Surgery/Laser | Require Medicine
Need An Eye Doctor | Do Not Need An Eye Doctor

HOSPITAL BASED | COMMUNITY BASED

BOTH ARE ESSENTIAL
VISION 2020
VISION 2020 AIM
The elimination of avoidable blindness (by the year 2020).

VISION 2020 EXPECTED RESULTS
1. To reduce the projected blindness estimate of 75+m in 2020 to less than 25m, thus
2. saving an estimated 100m. people from going blind and 400m person yrs of blindness,
3. resulting in an expected economic saving of over $150 billion between 2000 and 2020.

VISION 2020 - PARTNERSHIP
1. WHO + ministries of health.
2. NGDOs + professional groups.
3. People involved in eye care delivery.

VISION 2020 - THE REQUIREMENTS
1. The know how (strategy).
2. The resources (financial and human).
3. The motivation (ownership).

VISION 2020 - THE STRATEGY
Implement V2020 in manageable units. This can be for a population of between 250,000 to 2 million people. This is usually called District level health care.

VISION 2020 - THE COMPONENTS
1. Human resource development - People.
2. Infrastructure development - Financial resources.
3. Disease control - effective interventions, delivered efficiently and equitably

VISION 2020 - HUMAN RESOURCES
Minimum requirements
Community worker- 1 per 10 000.
Ophthalmic assistant/nurse - 1 per 100 000.
Ophthalmologist/cataract surgeon - 1 per 250 000.

VISION 2020 – GLOBAL PRIORITIES FOR 2000 - 2005
The diseases that are prioritised for phase 1 are -

- Cataract
- Refractive error + low vision
- Trachoma
- Onchocerciasis
- Vitamin A deficiency and childhood blindness.
- If strategies are already in place for the elimination of blindness due to these diseases, then attention should be given
- Glaucoma
- Diabetic retinopathy.
Cataract Blindness
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<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
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<td>16</td>
</tr>
<tr>
<td>Cataract blindness - Magnitude - Prevalence and incidence</td>
<td>17</td>
</tr>
<tr>
<td>Cataract blindness - Magnitude - Cataract can</td>
<td>18</td>
</tr>
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<td>19</td>
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<td>20</td>
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<td>20</td>
</tr>
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<td>21</td>
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<tr>
<td>Cataract blindness - Control - Cataract surgery efficiency and volume</td>
<td>22</td>
</tr>
<tr>
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<td>23</td>
</tr>
<tr>
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<td>24</td>
</tr>
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<td>26</td>
</tr>
<tr>
<td>Cataract blindness - Control - Cataract surgery coverage</td>
<td>27</td>
</tr>
<tr>
<td>Exercise 6 - Rapid assessment of cataract</td>
<td>28</td>
</tr>
<tr>
<td>Cataract blindness - Control - Cataract surgery outcome</td>
<td>29</td>
</tr>
<tr>
<td>Exercise 7 - Monitoring of cataract surgery outcome</td>
<td>32</td>
</tr>
<tr>
<td>Cataract blindness - Control - Cataract surgery cost</td>
<td>35</td>
</tr>
<tr>
<td>Exercise 8 - Cost of cataract surgery</td>
<td>37</td>
</tr>
<tr>
<td>Cataract blindness - Control - Improving cataract services</td>
<td>38</td>
</tr>
<tr>
<td>Exercise 9 - Improving cataract services</td>
<td>39</td>
</tr>
</tbody>
</table>
Cataract blindness - Definitions

Lens Opacity
Any opacification of the lens.

Cataract
Lens opacification causing "significant" visual loss.

“Operable Cataract”
Cataract requiring surgery, according to the patient’s visual requirements.

Cataract Blindness
Visual acuity less than 3/60 (in the better eye with available correction) due to cataract.

Exercise 1 - Definition of Cataract Blindness
In an eye clinic, the visual acuities in 10 people identified with cataract are -

<table>
<thead>
<tr>
<th>Right eye</th>
<th>Left eye</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HM</td>
<td>6/9</td>
</tr>
<tr>
<td>2. 6/9</td>
<td>6/12</td>
</tr>
<tr>
<td>3. 6/18</td>
<td>6/6</td>
</tr>
<tr>
<td>4. CF</td>
<td>6/6</td>
</tr>
<tr>
<td>5. 6/60</td>
<td>6/24</td>
</tr>
<tr>
<td>6. 5/60</td>
<td>3/60</td>
</tr>
<tr>
<td>7. 2/60</td>
<td>PL</td>
</tr>
<tr>
<td>8. PL</td>
<td>3/60</td>
</tr>
<tr>
<td>9. 6/6</td>
<td>6/9</td>
</tr>
</tbody>
</table>

What are the categories of vision in each eye and in each person?

How many eyes are blind?

How many people are blind?

How many eyes / people should have cataract surgery?
Cataract blindness – Magnitude
Prevalence and incidence

1. Prevalence (Backlog)
   1.1 People blind due to cataract:-
       People with visual acuity <3/60 in the better eye.
       0,50%.
       5 000 per million population.

   1.2 People not blind due to cataract but requiring cataract surgery:-.
       People with visual acuity 5/60-3/60 in the better eye (severe visual impairment).
       People with unilateral cataract causing blindness.
       People with second eyes for surgery.
       4 x prevalence of cataract blindness.
       2,00%.
       20 000 per million population.

   1.3 Total backlog of people requiring surgery:-
       2,50%.
       25 000 per million population.

2. Incidence (New Cases)
The mean life expectancy of a person who is blind due to age related cataract is 5 years.
The annual incidence approximates to 20% of the prevalence.
   2.1 People blind due to cataract:-
       0,10%.
       1 000 per million population per year.

   2.2 People not blind due to cataract but requiring cataract surgery:-
       4x incidence of cataract blindness.
       0,40%.
       4 000 per million population per year.

   2.3 Total number of new cases requiring cataract surgery each year:-
       0,50%.
       5 000 per million population per year.
Exercise 2 - Prevalence And Incidence Of Cataract

What is the population of your health district?

How many people in your health district are blind due to cataract? This is the prevalence (backlog) of people who are blind due to cataract.

How many people in your health district become blind due to cataract each year? This is the incidence (new cases) of blindness due to cataract each year.

How many people in your health district are not blind due to cataract but need cataract surgery?

How many new people in your health district need cataract surgery each year, even though they are not blind?

What is the total backlog of cases in your health district needing cataract surgery?

What is the total number of new cases in your health district needing cataract surgery each year?
Cataract blindness - Control
Barriers to cataract surgery
Only 1 out of 10 people who are blind due to cataract attend for surgery.

Only 1 out of 30 people with cataract who are not blind but who should have surgery attend for surgery.

There are 2 problems:
1. The blind cannot see and stay at home.
2. We stay in our clinics and do not see the blind!

The barriers precluding attendance for surgery can be:
On the side of the patient
On the side of the family
On the side of the community
On the side of the eye hospital.

They may be summarised as:
A - Awareness (lack of)
B - Bad service
C - Cost
D - Distance
E - Expectation (lack of).

Overcoming The Barriers - Cataract Case Finding
The use of cataract case finders in the community is a specific strategy that is recommended to case find people who need surgery and to overcome the barriers precluding surgery uptake.

Exercise 3 - Overcoming The Barriers
What do you think are the important barriers precluding cataract surgery uptake in your health district?

What strategies do you propose to overcome these barriers?
Cataract Surgery Efficiency, Volume, and Capacity

Surgery Efficiency, Surgery Volume, and Surgery Capacity
Efficiency = number of cases per hour per surgeon.
Low efficiency = 1 case per hour per surgeon.
Medium efficiency = 2-3 cases per hour per surgeon.
High efficiency = 4+ cases per hour per surgeon.

Volume = efficiency x time x number of surgeons.
Low volume = <20 surgeries per week (<1000 per year).
Medium volume = 20-40 surgeries per week (1000-2000 per year).
High volume = >40 surgeries per week (>2000 per year).

Capacity = maximum possible volume.

Principles of an Efficient Cataract Surgical Service
1. Committed OR team.
2. Staff well trained and well motivated, with clear job descriptions.
3. OR appropriately laid out (1 operating microscope + 2 tables per surgeon).
4. Good patient flow system in place (ward  preparation room  operating room  recovery room  ward).
5. Good standard surgical technique.
7. Good quality operating microscope.
8. Good spares back up, especially of essential instruments.
9. Good power back up.
10. Regular internal monitoring of the OR organisation.
11. Adequate stock of consumables.
12. Instrument technician available on stand by.

OR Team - Job Descriptions
1. Preparation Room

<table>
<thead>
<tr>
<th>CADRE</th>
<th>NUMBER</th>
<th>JOB DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ophthalmic Nurse</td>
<td>1</td>
<td>Over all supervision</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Local anaesthesia</td>
</tr>
<tr>
<td>Nurse</td>
<td>1</td>
<td>Check consent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pupil dilation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean eyes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IOP reducer</td>
</tr>
<tr>
<td>Counsellor</td>
<td>1</td>
<td>Pre- + post-op counselling</td>
</tr>
</tbody>
</table>
2. Operating Room –

<table>
<thead>
<tr>
<th>CADRE</th>
<th>NUMBER</th>
<th>JOB DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgeon</td>
<td>1</td>
<td>Surgery</td>
</tr>
<tr>
<td>Scrub Nurse</td>
<td>2</td>
<td>Laying of instrument trolleys</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assisting surgeon</td>
</tr>
<tr>
<td>Floor Nurse</td>
<td>1</td>
<td>Passing of consumables</td>
</tr>
<tr>
<td>Sterilisation Nurse</td>
<td>1</td>
<td>Cleaning + autoclaving of instruments</td>
</tr>
<tr>
<td>Porter</td>
<td>1</td>
<td>Patient flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Removal of waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cleaning of OR</td>
</tr>
</tbody>
</table>

3. Recovery Room

<table>
<thead>
<tr>
<th>CADRE</th>
<th>NUMBER</th>
<th>JOB DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse</td>
<td>1</td>
<td>Reception of patients</td>
</tr>
</tbody>
</table>

4. Post Surgery Activities

Cleaning of OR
Cleaning of instruments
Disposal of waste
Replacement of laundry
Checking of consumable stocks

**Exercise 4 - Improving The Surgery Capacity**

*What is the cataract surgery efficiency, volume, and capacity in the surgical centre in your health district?*

*What strategies could be implemented to increase the capacity?*
Cataract Surgery Rate

What Is The Cataract Surgery Rate (CSR)?
CSR = Number of cataract operations per million population per year.

The CSR can be calculated from -
1. The number of cataract surgeries (numerator, obtained from hospital OR records)
2. The population (denominator, obtained from census data).

What Should The CSR Be?
In order to eliminate blindness due to cataract, the CSR needs to equal the incidence (new cases) of cataract blindness.
Because not all the surgery that is done is on people who are blind due to cataract, it needs to be somewhere between 1 000 and 5 000.

The CSR that is required to equal the incidence is 2 000-3 000 cataract operations per million population per year.

If the CSR is less than 2 000, the surgery rate will not keep up with the incidence, some people who become blind due to cataract will remain untreated and will remain blind until they die, and the backlog will continue to increase.

If the CSR is 2 000-3 000 or more, the CSR will keep up with the incidence, people who become blind due to cataract will be treated and will be cured of their blindness, and the backlog will be abolished over a period of 5 years.

This applies if we use a visual acuity of <6/60 as the indication for cataract surgery.
If a better visual acuity is used as the indication, the required CSR increases –

<table>
<thead>
<tr>
<th>VISUAL ACUITY INDICATION FOR CATARACT SURGERY</th>
<th>CSR REQUIRED TO ELIMINATE CATARACT BLINDNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6/60</td>
<td>2000</td>
</tr>
<tr>
<td>&lt;6/36</td>
<td>3000</td>
</tr>
<tr>
<td>&lt;6/24</td>
<td>5000</td>
</tr>
<tr>
<td>&lt;6/18</td>
<td>10000</td>
</tr>
<tr>
<td>&lt;6/12</td>
<td>20000</td>
</tr>
</tbody>
</table>

What Are The CSRs?
The 2004 CSRs in 5 representative countries are -

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>CATARACT SURGERY RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanzania (2002)</td>
<td>313</td>
</tr>
<tr>
<td>Phillipines</td>
<td>1200</td>
</tr>
<tr>
<td>Brazil</td>
<td>2382</td>
</tr>
<tr>
<td>India</td>
<td>3650</td>
</tr>
<tr>
<td>Australia</td>
<td>8000</td>
</tr>
</tbody>
</table>
The estimated 2002 CSR’s in all the WHO regions are –

<table>
<thead>
<tr>
<th>WHO REGION</th>
<th>APPROXIMATE POPULATION (MILLIONS)</th>
<th>APPROXIMATE RANGE IN CATARACT SURGERY RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>672</td>
<td>&lt;100 - 2000</td>
</tr>
<tr>
<td>Americas</td>
<td>853</td>
<td>500 - 6000</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>503</td>
<td>&lt;100 - 4000</td>
</tr>
<tr>
<td>Europe</td>
<td>878</td>
<td>&lt;1000 - 6000</td>
</tr>
<tr>
<td>South East Asia</td>
<td>1590</td>
<td>&lt;500 - 4500</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>1717</td>
<td>&lt;500 - 7000</td>
</tr>
</tbody>
</table>

**Exercise 5 - Cataract Surgery Rate**

*Calculate the CSR for your district or country.*

*How does this compare to neighbouring areas and other parts of the world?*

*In order to achieve a CSR of 2000 in your district or country, how many cataract surgeries need to be done each year?*
Cataract Surgery Coverage

Definition
The cataract surgery coverage (CSC) is the proportion of people in the district that need cataract surgery that have had cataract surgery.

\[
\text{CSC} = \frac{\text{Number of people with operated cataract}}{\text{Number of people with cataract} + \text{Number of people with operated cataract}}
\]

Measurement
The CSC can be measured from a rapid assessment of 1000 people aged 50 years and older (20 clusters of 50).
The CSC should ideally be 100%, but it may be as low as 10%.
It provides a quantitative measure of cataract surgery in the community.

The rapid assessment of CSC can be combined with -
Rapid assessment of prevalence of all blindness (in people aged 50 years and over)
Rapid assessment of prevalence of cataract blindness (in people aged 50 years and over)
Rapid assessment of barriers to cataract surgery
Rapid assessment of cataract surgery outcome
Cataract case finding
Marketing of cataract surgery.

Twenty clusters are randomly selected, at each of which 50 randomly selected people aged 50 years and over are screened by an eye nurse and 2 assistants.

The assistants screen the selected individuals by -
Testing whether or not the visual acuity in each eye is 6/60 or better.
Asking whether or not they have had an eye operation.

All the people whose visual acuity in one or both eyes is less than 6/60, or who report having had an eye operation, are referred to the eye nurse for examination.

The eye nurse examines those people referred by -
Retesting the visual acuity in each eye.
Examining the eyes with a torch and / or ophthalmoscope, to ascertain whether or not there is a cataract or other significant eye pathology; and whether or not the eye has had cataract surgery.

Those people who are found to have cataract who have not had surgery are interviewed to ascertain why they have not attended for surgery.

Those people who are found who have had cataract surgery are interviewed to ascertain whether or not they are satisfied with the results of their surgery.

Someone from the district who has had successful surgery speaks to those people who need surgery about the availability and benefits of the surgery, and they are given a referral.
Exercise 6 - Rapid Assessment Of Cataract

In a rapid assessment of cataract -
1000 people aged 50 years and older were screened.
172 were found to have cataract with visual acuity less than 6/60.
156 were found to have cataract with visual acuity <3/60.
56 had had previous surgery.
Of these 56, 12 had a visual acuity between 6/6 and 6/18, 29 between 6/24 and 6/60, and 15 less than 6/60; 46 said they were happy with the results of the surgery, and 10 said they were unhappy.
Of the 172 found to have cataract with visual acuity less than 6/60, 86 said they did not know of the availability of cataract surgery services in the district.

What is the prevalence of blindness due to cataract?

What is the cataract surgery coverage?

What recommendations might you make to overcome the barriers to cataract surgery uptake?

What is the cataract surgery outcome?

What recommendations might you make to improve the outcome?
Cataract Surgery Outcome

What Factors Determine The Outcome Of Cataract Surgery?
1. The pre existing condition of the eye. Is there other significant pathology which may affect vision?
2. The expertise of the surgeon. Is it necessary for the surgeon to undergo additional training?
3. The surgical technique used. Is IOL implantation part of the surgery? Is biometry done?
4. The surgical facilities available. Are the operating microscope and microsurgical instruments adequate?
5. The follow up of the patient? Is there adequate post operative management? Is there adequate correction of residual refractive error post operatively?

What Should The Cataract Surgery Outcome Be?
The WHO recommendations for acceptable outcomes are -

1. Intraoperative complications - 5%-.

2. Visual acuity day 1 post op -

<table>
<thead>
<tr>
<th>Visual Acuity</th>
<th>Result</th>
<th>%</th>
</tr>
</thead>
</table>
| 6/6 - 6/18    | Good   | 40%+
| 6/24 - 6/60   | Okay   | 50% |
| <6/60         | Poor   | 10% (5% due to surgical complication) |

3. Visual acuity week 8 post op -

<table>
<thead>
<tr>
<th>Visual Acuity</th>
<th>Result</th>
<th>%</th>
</tr>
</thead>
</table>
| 6/6 - 6/18    | Good   | 85%+
| 6/24 - 6/60   | Okay   | 10% |
| <6/60         | Poor   | 5%-  |

How Should The Cataract Surgery Outcome Be Monitored?
Record any intraoperative complications in all patients after surgery.
Record the vision in the operated eye of all patients on day 1 after surgery + of all patients who return for follow up after 8 or more weeks.
If the vision is poor (<6/60), record the cause for this.
Samples of the forms for this monitoring are attached.

What Is The Purpose Of Monitoring The Outcome?
Monitoring of outcome is for self comparison of a surgeon or hospital over time.
It is not for comparison of one surgeon or hospital with another.
The purpose is to improve the quality of outcome over time.
It is guaranteed to facilitate this improvement.
# Cataract Surgery Outcome

**FORM A - Discharge Visual Acuity**

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Patient Name</th>
<th>Patient Number</th>
<th>Surgeon</th>
<th>IOL Y/N</th>
<th>Surgical complications</th>
<th>Visual acuity outcome</th>
<th>Cause of poor outcome (&lt;6/60)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good 6/6-6/18</td>
<td>Okay 6/24-6/60</td>
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</tbody>
</table>

**Totals**
## Cataract Surgery Outcome

### Form B - Week 8 Visual Acuity

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Patient Name</th>
<th>Patient Number</th>
<th>Surgeon</th>
<th>IOL Y/N</th>
<th>Visual Acuity Outcome</th>
<th>Cause of Poor Outcome (&lt;6/60)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good 6/6-6/18</td>
<td>Okay 6/24-6/60</td>
</tr>
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</tbody>
</table>

**Totals**

29
Exercise 7 - Monitoring Of Cataract Surgery Outcome

The discharge visual acuities for 20 cataract surgeries done by 2 surgeons at a Vision 2020 surgical centre are shown on the attached monitoring forms.

What percentage have a good outcome?

What percentage have a poor outcome?

What percentage of poor outcome is due to other pathology (“selection”)?

What percentage of poor outcome is due to intraoperative complication (“surgery”)?

What percentage of poor outcome is due to refractive error (“spectacles”)?

Which surgeon has the better results?

Which surgeon is the better surgeon?

Is the outcome within WHO recommendations?

What recommendations might you make to improve the outcome?
<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Patient Name</th>
<th>Patient Number</th>
<th>Surgeon</th>
<th>IOL Y/N</th>
<th>Surgical complications</th>
<th>Visual acuity outcome</th>
<th>Cause of poor outcome (&lt;6/60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/60</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/36</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/18</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3/60</td>
<td>Corneal oedema</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/60</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/60</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>6/60</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/24</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/12</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/60</td>
<td></td>
</tr>
</tbody>
</table>

Totals
# Cataract Surgery Outcome

## Form A - Discharge Visual Acuity

### Hospital: [Hospital Name]

### Surgeon: 2

### Period: [Period]

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Patient Name</th>
<th>Patient Number</th>
<th>Surgeon</th>
<th>IOL Y/N</th>
<th>Surgical Complications</th>
<th>Visual Acuity Outcome</th>
<th>Cause of Poor Outcome (&lt;6/60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good 6/6-6/18</td>
<td>6/60</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Okay 6/24-6/60</td>
<td>3/60 Glaucoma</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Poor &lt;6/60</td>
<td>4/60 Diabetic retinopathy</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>6/18</td>
</tr>
<tr>
<td>5</td>
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<td></td>
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<tr>
<td>6</td>
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<td>8</td>
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<td>6/24</td>
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<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/36</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6/60</td>
</tr>
</tbody>
</table>

**Totals:**

- Good 6/6-6/18: [Count]
- Okay 6/24-6/60: [Count]
- Poor <6/60: [Count]
Cataract Surgery Cost

Cost And Price
Cost = cost of surgery to the provider
Price = price of surgery to the receiver
Price < cost → subsidy
Price > cost → profit
Price = cost → break even.

Breakdown Of Cost For Cataract Surgery
Capital -
  Buildings
  Instruments and equipment
Running -
  Fixed / overheads -
    Salaries
    Utilities
  Variable -
    Consumables.

How Can We Make Cataract Surgery More Affordable?
Step 1 - Cost containment
Step 2 - Cost recovery
Step 3 - Income generation.

Cost Containment - Increased Number Of Surgeries (Economy Of Scale)
The fixed / overhead costs remain the same, however many operations are done.
Therefore, increased number of surgeries → decreased unit cost per surgery.
This is achieved by increasing the uptake + the capacity.

<table>
<thead>
<tr>
<th>No. of Patients</th>
<th>Cost of Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td></td>
</tr>
</tbody>
</table>
Cost Containment - Purchase Of Cheap Consumables

Strategies include -
Low cost technologies
Sourcing of cheap consumables
Bulk purchases.

Cost Recovery Model
A model from LV Prasad Institute in Hyderabad, India for cost recovery and cost sharing
is -

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VIP</td>
<td>$100</td>
<td>5%</td>
<td>Profit</td>
</tr>
<tr>
<td>De luxe</td>
<td>$60</td>
<td>10%</td>
<td>Profit</td>
</tr>
<tr>
<td>Economy</td>
<td>$30</td>
<td>20%</td>
<td>Break even</td>
</tr>
<tr>
<td>Non paying</td>
<td>Free</td>
<td>65%</td>
<td>Internal subsidy / cost sharing.</td>
</tr>
</tbody>
</table>

The profit from the patients paying the “VIP” and “de luxe” rates is used to subsidise the non paying patients.
The non clinical care varies between the 4 grades.
The clinical care is standardised for all 4 grades.

Income Generation And External Subsidy
Income generation (independent) - Fees for less essential clinical services - Non surgical
Surgical
Other business activities
Government
Local NGO
International NGO.

External subsidy (dependent) -

Income generation should be used to cover running costs.
External support should be used for capital costs.

Cost Of Cataract Surgery And Vision 2020

1. The total cost per cataract surgery should be US$100 (2000 cataract surgeries per year, US$1 million total cost to fund a Vision 2020 programme for 5 years).
2. This cost should be shared 50-50 between MOH and the NGO / donor agency, with increasing financial responsibility being taken by the MOH over a 5 year period, so that donor funding can be withdrawn after 5 years.
3. Because of economy of scale and the exponential increase in unit costs with decreased numbers of surgeries done, it is not possible to reduce the unit costs of cataract surgery to an acceptable level of US$100 if the cataract surgery numbers are less than 2 000.
Exercise 8 - Cost Of Cataract Surgery

Because of budget constraints, the management of a district hospital has decided to curtail all elective surgery.

The population of the district is 1 million.

Last year, 750 cataract surgeries were done.

This year, the cataract surgeon has been restricted to doing 20 cataract surgeries per month.

The cost of the consumables for each operation is US$25.

The estimated annual fixed costs (overheads) are US$150 000.

What should the CSR be for the district?

What was the CSR last year?

What will the CSR be this year?

What was the total cost for cataract surgery last year?

What will the total cost for cataract surgery be this year?

How much money will the hospital save?

What was the cost per cataract surgery last year?

What will the cost per cataract surgery be this year?

What would the cost per cataract surgery be if -

0 cataract surgeries were done?

500 cataract surgeries were done?

1000 cataract surgeries were done?

1500 cataract surgeries were done?

2000 cataract surgeries were done?

Plot these costs on a graph.

To meet the cost recommendations for Vision 2020, what is the minimum number of cataract surgeries that should be done at the hospital each year?

What recommendations might you make to the hospital management?
Improving Cataract Services

Recommendations
The objectives of our cataract services are -

High quality (outcome)
High quantity (output)
Low cost (outlay).

The recommendations are -

1. Outcome (quality) -
   Day 1 visual acuity - 6/6 - 6/18 40%+
   6/24 - 6/60 50%
   <6/60 10% (5% due to surgical complication).
   Week 8 visual acuity - 6/6 - 6/18 85%+
   6/24 - 6/60 10%
   <6/60 5%-

2. Output (quantity) -
   2 000 per million population per year.

3. Outlay (cost) -
   US$100 per surgery total cost.
   US$25 per surgery consumables.
   Self sustaining, with no external support.

Improving Outcome
1. Monitor outcome
2. Convert to IOL surgery.
3. Include biometry.
4. Consider small incision surgery.

Improving Output
Is there a waiting list?
No → Increase demand → Consider barriers to delivery -
   Awareness - Health education
   Accountability - Improve quality of patient care
   Affordability - Decrease cost
   Accessibility - Take surgery to the patient, or patient to the surgery.

Yes → Increase capacity → Consider surgery efficiency + surgery volume -
   Surgery efficiency - OR lay out
   OR division of labour
   OR routines
   Surgery volume - Number of surgeons
   OR time.
Reducing Cost

1. Cost containment - Increase number of surgeries
   Purchase cheap consumables.
2. Cost recovery and cost sharing - Multi tier system, with cross subsidisation.
3. Income generation from other sources.
4. External support, only as a last resort.

Exercise 9 - Improving Cataract Services

As a district Vision 2020 programme manager, you have the task of improving the cataract surgery services in your district - quality, quantity (uptake + capacity), and cost.

How do you plan to do this?
Childhood Blindness
And Visual Loss
**Definition**

Childhood blindness is defined as a best corrected visual acuity of <3/60 in the better eye of an individual under the age of 16 years.

**Prevalence**

**Blindness and Severe Visual Impairment in Children in Different Countries**

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Reference</th>
<th>Year</th>
<th>Prevalence/1,000 children</th>
<th>Age group (yrs)</th>
<th>Source of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>Iceland</td>
<td>Halldorsson</td>
<td>1980</td>
<td>0.36</td>
<td>0-14</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>England</td>
<td>RNIB</td>
<td>1985</td>
<td>0.10</td>
<td>0-4</td>
<td>Registration</td>
</tr>
<tr>
<td></td>
<td>England</td>
<td>RNIB</td>
<td>1985</td>
<td>0.22</td>
<td>5-9</td>
<td>Registration</td>
</tr>
<tr>
<td></td>
<td>England</td>
<td>RNIB</td>
<td>1985</td>
<td>0.23</td>
<td>10-14</td>
<td>Registration</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>Stewart-Brown</td>
<td>1988</td>
<td>0.34</td>
<td>10</td>
<td>Cohort study</td>
</tr>
<tr>
<td></td>
<td>Eire</td>
<td>Goggin</td>
<td>1991</td>
<td>0.20</td>
<td>0-16</td>
<td>Estimate</td>
</tr>
<tr>
<td></td>
<td>Scandinavia</td>
<td>Riise</td>
<td>1992</td>
<td>0.15-0.41</td>
<td>0-15</td>
<td>Registration</td>
</tr>
<tr>
<td>Asia</td>
<td>Nepal</td>
<td>Brilliant</td>
<td>1980</td>
<td>0.63</td>
<td>0-14</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>Cohen</td>
<td>1985</td>
<td>0.64</td>
<td>0-5</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>- urban</td>
<td>1985</td>
<td>1.09</td>
<td>0-5</td>
<td>Survey</td>
</tr>
<tr>
<td>Africa</td>
<td>Malawi</td>
<td>Chirambo</td>
<td>1983</td>
<td>1.10</td>
<td>0-5</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>The Gambia</td>
<td>Faal</td>
<td>1986</td>
<td>0.70</td>
<td>0-19</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Benin</td>
<td>WHO</td>
<td>1991</td>
<td>0.60</td>
<td>0-15</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Morocco</td>
<td>WHO</td>
<td>1994</td>
<td>0.30</td>
<td>0-15</td>
<td>Survey</td>
</tr>
</tbody>
</table>

**SUMMARY**

<table>
<thead>
<tr>
<th>Country</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrialised</td>
<td>0.3/1000 Children</td>
</tr>
<tr>
<td>Middle Developing</td>
<td>0.6/1000</td>
</tr>
<tr>
<td>Poor Developing</td>
<td>0.9/1000</td>
</tr>
<tr>
<td>Very Poor</td>
<td>1.2/1000</td>
</tr>
</tbody>
</table>

The global figure is estimated at 1.5 million (7/10,000 children).

**Estimation/ million pop**

\[ \text{Total Population} \times \text{Proportion of Population who are Children} \times \text{Prevalence} \]

**Example:**

1. Population 1,000,000
2. 40% Population aged 0-15yrs
3. Prevalence 0.5/1000 children
4. **Number of Blind Children** = \( \frac{1,000,000 \times 40 \times 0.5}{100 \times 1000} \) = 200 Blind Children per Million population
Causes
It is difficult to obtain good epidemiological data because:

A POPULATION BASED SURVEYS
Problems:
1. Low prevalence - therefore large sample.
2. Case definition in babies and infants is often difficult.
3. Lost ‘cases’ in institutions.

B BLIND SCHOOL CHILDREN SURVEYS
Problems:
Selection bias against
1. rural blind
2. pre-school blind
3. multiple disabilities

Summary
The simplest way to estimate the causes of childhood blindness is to examine approximately 200 blind children from blind schools and/or hospital clinics.

The causes of childhood blindness can be classified in two ways:

Anatomically - according to the anatomical site of lesion in the eye.  
Aetiologically - relating to when the insult occurred which resulted in blindness
i). hereditary
ii). intra-uterine
iii). peri-natal
iv). childhood

Surveys conducted in various countries have shown a wide variation in the different causes of childhood blindness.

Corneal blindness may account for up to 50% of all childhood blindness in some poor areas of the world.

Cataract is responsible for between 10-20% of all childhood blindness. Glaucoma in childhood is responsible for between 1-2% of all childhood blindness. It is possible that some congenital cataract and glaucoma in childhood is a result of rubella infection in pregnancy. The extent to which the rubella infection, affecting the unborn child, influences childhood blindness is not yet clear although it probably constitutes somewhere between 5-10% of all cases of childhood blindness.

Retinal diseases are an important cause in the intermediate and more developed countries. Retinal diseases are due to certain hereditary conditions and also due to retinopathy of prematurity (ROP) which is becoming an increasingly important cause of childhood blindness in cities of the developing world due to the survival of low birth weight children.
## Results of Blind School Studies

<table>
<thead>
<tr>
<th>Region</th>
<th>Latin America</th>
<th>Africa</th>
<th>Asia</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>830</td>
<td>1407</td>
<td>2235</td>
<td>781</td>
</tr>
<tr>
<td>Countries</td>
<td>7</td>
<td>10</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Retina</strong></td>
<td>40%</td>
<td>31%</td>
<td>27%</td>
<td>32%</td>
</tr>
<tr>
<td><strong>Anomalies</strong></td>
<td>13%</td>
<td>24%</td>
<td>24%</td>
<td>23%</td>
</tr>
<tr>
<td><strong>Cornea</strong></td>
<td>10%</td>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Glaucoma</strong></td>
<td>10%</td>
<td></td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Cataract</strong></td>
<td>8%</td>
<td></td>
<td>12%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Genetic</strong></td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>45%</td>
</tr>
<tr>
<td><strong>Perinatal</strong></td>
<td>20%</td>
<td>30%</td>
<td>25%</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- The percentages for each region represent the proportion of cases for each category.
- The regions listed are Latin America, Africa, Asia, and Europe, with respective sample sizes and numbers of countries studied.
Control of Childhood Blindness

1. Why are children blind?
   Examine 200 blind children

2. Which causes are avoidable?
   Which can be prevented?
   Which can be treated?

3. How can we prevent these diseases?
   Primary prevention - prevent disease occurring
   Secondary prevention - prevent visual loss from disease
   Tertiary prevention - restore vision

4. Methods of Control
   (a) Integration in Health Care System

<table>
<thead>
<tr>
<th>HEALTH SERVICE INFRASTRUCTURE</th>
<th>LEVEL OF SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3°</td>
<td>RICH</td>
</tr>
<tr>
<td>2°</td>
<td>MIDDLE</td>
</tr>
<tr>
<td>1°</td>
<td>POOR</td>
</tr>
<tr>
<td>0</td>
<td>15ys</td>
</tr>
</tbody>
</table>

   (b) Specific disease control
   This is considered as
   preventive measures for CORNEAL diseases
   surgical measures for CATARACT, GLAUCOMA and R.O.P.
   optical measures for LOW VISION / REFRACTIVE ERRORS
Cataract in Children

Definition
A lens opacity which reduces vision in a child aged 0-15 years.

Magnitude
15% of childhood blindness = 30 children / million population are blind

Incidence  -  at least 10 new cases / million population/ year
- 1/2000 live births

Causes
Non-traumatic
- Hereditary (autosomal dominant)  25%
- Rubella  20% (variable)
- Others  5%
- Unknown  50%

Traumatic (usually 1 eye)

Control
Primary  -  rubella immunisation
Secondary  treat aphakia and amblyopia
Tertiary  -  early, good surgery, excellent follow-up (low vision services)
Role of IOL surgery is changing.
Glaucoma in Children

Definition
Raised intraocular pressure leading to optic nerve damage and decreased vision in children.

Magnitude
1-10% of childhood blindness = 2-20 children / million population are blind
Incidence - 1/10,000 live births = 1-2 cases / million population / year

Causes
Primary
  Hereditary
  Unknown
Secondary
  Rubella
  Anomalies (e.g., iris root abnormalities)

Control
Primary - Rubella immunisation / genetic counselling
Secondary - Early diagnosis and surgery
  Treat amblyopia + refractive errors
Tertiary - Low vision services
Retinopathy of Prematurity

Classification

By Stage:

1. Demarcation line - thin white line within the retina separating avascular and vascular retinal regions.
2. Ridge - the line is larger than 1 (above) and raised out of the plane of the retina
3. Ridge with extra retinal fibrovascular proliferation - the raised line is associated with fibrovascular proliferation out of the retina.
4. Sub-total retinal detachment.
5. Total retinal detachment.

PLUS DISEASE - tortuosity of the posterior pole retinal vessels which may be associated with iris engorgement and vitreous haze.

By Zone:

Zone 1 - posterior pole (central 30°)
Zone 2 - up to periphery of nasal retina
Zone 3 - up to periphery of temporal retina

The more posterior (by zone) the ROP, the greater the likelihood of progression to stage 3. ROP totally confined to zone 3 does not progress to stage 3.

CLOCK HOURS - each clock hour represents a 30° segment of the 360° circle.

The more extensive the ROP by clock hour the greater the tendency to progress, and this goes with more posterior disease.

STAGE 3 PLUS DISEASE IDENTIFIES A CHILD IN NEED OF TREATMENT WHEN THERE ARE 5 OR MORE CLOCK HOURS OF CONTINUOUS; OR 8 OR MORE CUMULATIVE CLOCK HOURS OF STAGE 3 DISEASE. THIS IS KNOWN AS ‘THRESHOLD DISEASE’.
Screening for ROP
Consider screening if:

1. ROP accounts for more than 10% of new admissions/registrations of blind children.
   or

2. In a neonatal unit where, each year, 100 babies (or more) with birth weights of less than 1500gms who are surviving to 6 weeks of age.

Flow Chart

```
SCREEN

Birth wt > 1500gms (variable) and Gestational Age > 32 wks

No

Birth wt < 1500gms (variable) or Gestational Age < 32 wks

Yes

Screen every 2 weeks from 6 weeks after birth until

Stage 3 Plus Threshold

Treat with Cryo or Laser

Unfavourable outcome in 22% eyes

36 weeks P.M.A. or Zone 3 Vascularised

OK but watch for refractive errors and strabismus

Favourable outcome (78%) Watch for strabismus (squint) / refractive errors
```
ROP Screening

**Indication**

<table>
<thead>
<tr>
<th>Weight</th>
<th>Screening Unnecessary or Screening Indicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500 grams (variable)</td>
<td></td>
</tr>
<tr>
<td>500 grams</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Birth Gestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 weeks</td>
</tr>
<tr>
<td>24 weeks</td>
</tr>
</tbody>
</table>

**ROP: Schedule for Screening**

<table>
<thead>
<tr>
<th>BIRTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>etc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCREEN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

Repeat if R.O.P.

Discharge: no ROP at second screen
or: ROP regressing
or: Retina vascularised to periphery
Treat ROP stage 3 threshold

**Treatment of ROP**

Stage 3 plus threshold disease should be treated as soon as possible after diagnosis and within 1 week at the latest. The time window available for treatment, and retreatment if necessary, is short - about 2-3 weeks. Treatment is usually around 36-44 weeks postconceptual age (mean 37.7 weeks).

Treatment can be performed in the neonatal unit under sedation and local anaesthetic drops. It is important to have a neonatologist present when treatment is being given.

Cryotherapy or laser is applied to the whole of the area of avascular retina. If cryo is used, freeze anterior to the ridge, immediately on seeing white, stop, thaw and move to the adjacent new site. Usually two rows are required.

Following treatment the infant should continue to be seen at regular intervals for follow-up. The results of cryotherapy for stage 3 plus disease reduce the progression to stage 4 and 5 disease from approximately 50% to 25%.
## Surgically Avoidable Childhood Blindness

<table>
<thead>
<tr>
<th>Amount of blindness in blind schools</th>
<th>ROP</th>
<th>Cataract in Childhood</th>
<th>Glaucoma in Childhood</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td></td>
<td>15%</td>
<td>8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incidence /10,000 births</th>
<th>4</th>
<th>4</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases/million population</td>
<td>10</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>ROP</th>
<th>Cataract</th>
<th>Glaucoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 3 disease: Raised ridge with fibrovascular proliferation and posterior vessel Tortuosity</td>
<td>Abnormal red reflex White pupil</td>
<td>Large eye Hazy cornea Raise IOP Cupped disc</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment</th>
<th>ROP</th>
<th>Cataract</th>
<th>Glaucoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cryo. or laser to the avascular zone, 360° circumference.</td>
<td>ECCE surgery with IOL</td>
<td>Goniotomy or Trabeculotomy or Others</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Problems</th>
<th>ROP</th>
<th>Cataract</th>
<th>Glaucoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness Screening - paediatricians - ophthalmologists</td>
<td>Late diagnosis. Ref error correction Amblyopia</td>
<td>Late surgery Long-term Control</td>
<td></td>
</tr>
</tbody>
</table>

### Strategy for Surgically Avoidable Blindness in Children

<table>
<thead>
<tr>
<th>Disease</th>
<th>Activity</th>
<th>Manpower</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROP</td>
<td>Screen all babies less than 1500gms (variable)</td>
<td>Ophthalmologist</td>
</tr>
<tr>
<td>Cataract</td>
<td>Screen all newborn babies</td>
<td>Paediatricians Parents</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>Treat 10 ROP /year</td>
<td>Ophthalmologist Anaesthetist Paediatrician Nurse</td>
</tr>
<tr>
<td>ROP</td>
<td>Treat 10 cataracts/year</td>
<td>Anaesthetist</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>Treat 2 glaucomas/year</td>
<td>Nurse</td>
</tr>
<tr>
<td>ROP</td>
<td>Follow-up Low Vision Services</td>
<td>Ophthalmologist Educationalist Optician Orthoptist</td>
</tr>
<tr>
<td>Cataract</td>
<td>* for at least 20 years</td>
<td></td>
</tr>
<tr>
<td>Glaucoma</td>
<td>* disease evaluation includes:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* intraocular pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* refraction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* amblyopia treatment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* optical - low vision devices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* educational needs</td>
<td></td>
</tr>
</tbody>
</table>

### MATERIAL NEEDS

- Indirect ophthalmoscope
- Portable cryo unit or laser
- Anaesthesia equipment for children
- Instruments for aspiration/lensectomy/trabeculotomy
- Spectacles (or contact lenses)
- Low vision devices
Significant Refractive Error in School Children

Aim
To detect significant refractive errors which require spectacle correction.
Usually considered myopia of 1D, astigmatism 1.5D, hyperopia 3D or more in better eye.

Needs
Approximately 5000 children aged 5-15 years / million total population have refractive errors greater than -1.00 dioptre sphere in both eyes. (Variable prevalence.)

Strategy
1. If possible, screen all children once between ages 10-15 years.
2. Use binocular vision of 20/40 (6/12) or less for assessing moderate to severe refractive errors. (Testing can be done by trained teachers/health workers.)
3. Spectacles to be given for:
   Myopia 1 dioptre sphere or more both eyes
   Astigmatism 1.5 dioptre cylinder or more both eyes
   Hypermetropia +3 dioptres spheres or more with symptoms
Low Vision Services

Definition
Best corrected Vision less than 6/18 in the better eye to P.L.

Aim
To reduce the time individuals spend with visual disability by providing optical and low vision services.

Resources Required

<table>
<thead>
<tr>
<th>MANPOWER</th>
<th>Optometrist/Therapist/(Ophthalmologist)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td>Magnifiers (hand, stand)</td>
</tr>
<tr>
<td></td>
<td>Telescopes (hand, spectacles)</td>
</tr>
</tbody>
</table>

Priority
- Children
- Aphakes
- Myopes
- Albinism
- Macular disease

Strategy
1. Detect case
   - In blind schools
   - From ophthalmologists

2. Assessment
   - Ophthalmologist - diagnosis, prognosis
   - Optometrist - refraction ± magnification needs
   - Therapist - skill/function needed
     - e.g., reading distance from blackboard etc.

3. Prescription
   - a) near, medium or distance
   - b) spectacles, hand or stand magnifier, telescope
   - c) low cost, locally made or expensive high-tech

4. Education, Motivation and Follow-up

Summary
1. Many children in blind schools can benefit from spectacles and/or low vision devices.
2. or more of children with 1/60 vision can read normal size print if provided spectacles and/or magnifiers.
3. Low vision services are important to maximise functional vision particularly in children.
4. Low vision devices (magnifiers and telescopes) can be made locally for less than $20 each.
5. Children with vision <6/60 - 1/60 are the priority group for treatment.
### Summary of Control of Childhood Blindness (By Disease)

<table>
<thead>
<tr>
<th>Anatomical Level</th>
<th>Number/ million population</th>
<th>PRIMARY (Prevent the disease)</th>
<th>SECONDARY (Prevent Visual Loss)</th>
<th>TERTIARY (Restore Vision)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORNEA</td>
<td></td>
<td>Nutrition Education Measles immunisation</td>
<td>Early treatment of corneal Disease</td>
<td>Corneal grafting Low vision services</td>
</tr>
<tr>
<td>LENS</td>
<td></td>
<td>Rubella immunisation Genetic counselling</td>
<td>Early surgery Amblyopia treatment</td>
<td>Early good surgery Good follow-up Low vision services</td>
</tr>
<tr>
<td>RETINA</td>
<td></td>
<td>Avoid low birth weight Avoid hyperoxia</td>
<td>Screening for ROP and treatment</td>
<td>Low vision services</td>
</tr>
<tr>
<td>GLAUCOMA</td>
<td></td>
<td>Rubella immunisation Genetic counselling</td>
<td>Early, good surgery Good follow-up</td>
<td>Low vision services</td>
</tr>
<tr>
<td>OPTIC N /H.V.P</td>
<td></td>
<td>Good antenatal and peri-natal care</td>
<td>----</td>
<td>Low vision services</td>
</tr>
<tr>
<td>WHOLE GLOBE</td>
<td></td>
<td>Avoid medication in pregnancy</td>
<td>----</td>
<td>Low vision services</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200-400 /million total population</strong> or <strong>0.5/1000 children</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Summary of Control of Childhood Blindness (By Age and Health Service)

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>NEONATES</th>
<th>PRE-SCHOOL</th>
<th>SCHOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Prevent ophthalmia neonatorum</td>
<td>Screen for amblyopia</td>
<td>Screen visual acuity</td>
</tr>
<tr>
<td>Community</td>
<td>Examine babies eyes</td>
<td>Prevent xerophthalmia</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>Refer cataract and glaucoma</td>
<td>Treat corneal disease</td>
<td>Provide spectacles</td>
</tr>
<tr>
<td>Mid-level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>Screen &amp; treat ROP</td>
<td>Specialist surgical Low vision services</td>
<td>Treatment of severe ocular injuries</td>
</tr>
<tr>
<td>Referral</td>
<td>Treat cataract and glaucoma</td>
<td>Low vision services</td>
<td>Low vision services</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

Nutrition education and measles immunisation programmes should result in the virtual eradication of corneal blindness in childhood.

Rubella immunisation may be effective in some countries preventing childhood blindness from congenital cataract and glaucoma.

Screening of newborn children for cataract, glaucoma; and screening of low birth weight children for retinopathy of prematurity, followed by the provision of specialist ophthalmological surgical services could prevent visual loss from these three potentially treatable surgical conditions.

Many children with severe visual loss/blindness can be helped to read normal print with spectacles and/or low vision devices.

The causes of childhood blindness are changing as corneal disease is gradually reduced and cataract and glaucoma become increasingly important causes, with ROP emerging as the most potentially preventable cause of childhood blindness in urban situations.

It is necessary to monitor closely the changing patterns of childhood blindness in each individual country so that appropriate preventive and therapeutic measures can be initiated to reduce the number of blind years from avoidable causes of blindness in children.
Vitamin A Deficiency
Vitamin A Deficiency Classification

XN - Night blindness
XF - Xerophthalmic fundus
XIA - Conjunctival xerosis
XIB - Bitot’s spot
X2 - Corneal xerosis
X3A - Corneal ulcer, less than 1/3 of cornea
X3B - Corneal ulcer, 1/3 or more of cornea
XS - Corneal scar

Night Blindness XN
- cause is lack of rhodopsin in the retinal photoreceptors (rods)
- usually reversible in 48 hours with treatment
- other causes: retinitis pigmentosa; onchocerciasis

Conjunctival Xerosis XIA
- due to absence of goblet cells, with decrease in mucin and squamous metaplasia of conjunctival cuboidal epithelium
- often difficult to see, especially in inflamed eyes
- usually temporal then inferior conjunctiva
- improves in 2-4 days with treatment

Bitot’s Spots XIB
- appearance due to keratinisation and secondary infection with gas forming Corynebacterium xerosis
- white or grey, cheesy or foamy spots usually at the temporal conjunctiva
- may take weeks or months to resolve with treatment, and some never resolve

Corneal Xerosis X2
- drying of the cornea
- first sign is a very fine punctate keratopathy usually infero-nasally
- there is decreased wettability of the cornea
- corneal oedema appears and there is marked punctate staining with fluorescein
- in severe cases keratin may form on the corneal epithelium

Corneal Ulceration X3
- it is likely that there are different mechanisms
  a. small sharply demarcated ulcers, usually infero-nasally
  b. stromal necrosis, localised or generalised, often beneath an intact epithelium; called keratomalacia
- these mechanisms are not definitely understood
- the mechanism in a) is possibly due to an epithelial ‘cyst’ rupturing, or possibly due to eyelid trauma over an area of metaplasia
- the mechanism in b) is necrosis of corneal matrix (collagen and mucopolysaccharides) usually without inflammatory sintrns:
- corneal ulceration takes 5-7 days to heal with scar formation providing that there is normal cornea left
  X3A - ulceration of less than 1/3 of the cornea
  X3B - ulceration of 1/3 or more of the cornea
Assessment of Vitamin A Deficiency

- are children poor and under-nourished?
- is corneal scar (XS) causing 10% or more of new admissions to blind schools?
- is keratomalacia (X3) seen in hospital records?
- if two or three of the above are present, consider a population based survey.

Survey

```
\begin{center}
\begin{tikzpicture}
\draw (0,3) -- (0,0) -- (4,0) -- (0,3);
\fill[fill=white,draw=black] (0,3) -- (1,2) -- (2,1) -- (3,2) -- (0,3);
\draw (1,2) -- (2,1) -- (3,2) -- (1,2);
\draw (0,3) -- (1,2) -- (2,1) -- (3,2) -- (0,3);
\node at (2,1) {Abnormal C.I.C.};
\node at (1,2) {Clinical X1B};
\node at (3,2) {Sub-clinical Low Serum Retinol};
\node at (0,3) {Normal};
\node at (2,4) {Keratomalacia};
\node at (1,3) {Bitot spots};
\node at (3,3) {Normal};
\end{tikzpicture}
\end{center}
```

- children aged 1-6 years
- clinical
  - Bitot's spot (X1B)
  - Corneal scar (XS)
  - Active corneal disease (X2, X3)
- sub-clinical
  - Conjunctival impression cytology (CIC)
  - Blood retinol (sub-sample)

Example:
Survey of 2000 Children for Bitot's Spots
if ten or more Bitot's spot found: a problem exists (XIB = 10/2000 or 0.5%)

Bitot’s spots seem to be less common in Africa compared with South Asia

Risk Factors for Xerophthalmia

1. **Age**
   - X2 / X3 1-4 years
   - XN / X1B increasing from 1-8 years
2. **Males**
   - Boys > Girls (even if they are on the same diet)
3. **Mother’s Milk**
   - Non breast feeding children 3 - 4 x greater risk
4. **Measles**
   - Children with measles at greater risk
5. **Malabsorption - Diarrhoea**
   - Children with recurrent, chronic diarrhoea at greater risk
6. **Malnutrition**
   - Children who are ‘malnourished’ e.g., marasams, Kwashiorkor, at greater risk
7. **Maternal Education**
   - Children of mothers with no schooling at greater risk
### Effect of Vitamin A Supplements on Mortality of Children in Developing Countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number enrolled</th>
<th>Vitamin A Dose (IU)*</th>
<th>Interval Between Doses (months)</th>
<th>Outcome †</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ratio</td>
</tr>
<tr>
<td>Indonesia</td>
<td>25,200</td>
<td>200 000</td>
<td>6</td>
<td>0.73</td>
</tr>
<tr>
<td>(N Sumatra)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>28,630</td>
<td>&lt;200 000 (age graded)</td>
<td>4</td>
<td>0.70</td>
</tr>
<tr>
<td>(Lowland)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>7,197</td>
<td>&lt;200 000 (age graded)</td>
<td>Once only</td>
<td>0.74</td>
</tr>
<tr>
<td>(Highland)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>15,419</td>
<td>8333</td>
<td>0.25</td>
<td>0.46</td>
</tr>
<tr>
<td>(Tamil Nadu)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>15,775</td>
<td>200 000</td>
<td>6</td>
<td>0.94</td>
</tr>
<tr>
<td>(Andhra Pradesh)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ghana</td>
<td>21,906</td>
<td>&lt;200 000 (age graded)</td>
<td>4</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sudan ‡</td>
<td>28,492</td>
<td>200 000</td>
<td>6</td>
<td>1.06</td>
</tr>
<tr>
<td>Measles Studies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td>180</td>
<td>200 000</td>
<td>2 doses 1 d interval</td>
<td>0.50</td>
</tr>
<tr>
<td>South Africa</td>
<td>189</td>
<td>400 000</td>
<td>Once only</td>
<td>0.21</td>
</tr>
</tbody>
</table>

*1 IU=0.3 µg retinol = 1.05 nmol retinol.

† Ratio = ratio of treated to control mortality rates; p=probability that treated and control group mortalities were equal. A ratio <1 indicates a positive effect of supplements.

‡ This study found a highly significant inverse correlation between dietary vitamin A intake and risk of mortality in children in same community.

§ p<0.05 for children under 2 years.

Vitamin A supplementation to children in areas where vitamin A deficiency is likely to be a problem, reduces child mortality significantly.
Control of Vitamin A Deficiency

1. **Short-term**
   - Vitamin A capsules 200,000 i.u. to children at high risk, e.g., measles, malnourished.
   - Treatment of children with clinical xerophthalmia, (e.g., X3, X2, X1B, XN) one capsule on first, second and fifteenth day.
   - Vitamin A 400,000 i.u. to mother at childbirth.

2. **Mid-term**
   - Remove risk factors
   - Measles immunisation (more in Africa)
   - Diarrhoea control (more in Asia)

3. **Long-term**
   - Improve nutrition of children and pregnant mothers
     - available, affordable, acceptable
     - appropriate in different societies

Treatment of Xerophthalmia

The treatment schedules given below apply to all stages of active xerophthalmia, including night blindness, conjunctival xerosis, Bitot’s spots, corneal xerosis, and keratomalacia. The oral administration of large doses of vitamin A is the recommended method of treatment. The first dose should be given immediately xerophthalmia is recognised. Patients with acute corneal lesions should be referred, whenever this is possible, directly to a hospital for treatment of their general condition as well as of their eye disease.

**Children under 6 years old**

Children over 1 year and under 6 years old treat as shown in the table below.

<table>
<thead>
<tr>
<th>Xerophthalmia Treatment Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediately on diagnosis</td>
</tr>
<tr>
<td>The following day</td>
</tr>
<tr>
<td>4 weeks later</td>
</tr>
</tbody>
</table>

*Note:* if there is persistent vomiting or profuse diarrhoea, an intramuscular injection of 100,000 IU of water-miscible vitamin A (but not an oil-based preparation) may be substituted for the first dose. The use of sterile syringes and needles is, of course, essential.

**Children under 1 year old and children of any age who weigh less than 8kg**

Treat with half the doses shown in the table above.
Notes on treatment of young children

Children with diarrhoea may absorb rather less of the vitamin A than other children, but if the doses recommended above are used they should still absorb enough for the treatment to be adequate. Xerophthalmic children with severe protein-energy malnutrition need to be carefully monitored because their vitamin A status is unstable and may rapidly worsen, even when they are treated with the doses recommended. Additional doses may then be required for them.

Oil-based preparations are the preferred formulation for oral administration of vitamin A, but water-miscible preparations may be used if the oily solution is not available. If large-dose capsules or concentrated syrup are not available, vitamin A in an equivalent dosage may be given by mouth in other forms, such as fish-liver oil. Oil-based preparations are normally well absorbed by the body when they are administered orally, but they should never be injected since oil-based vitamin A is liberated extremely slowly from the injection site. The only preparation suitable for injection, intramuscularly, is water-miscible vitamin A.

Involvement of the cornea in xerophthalmia is a medical emergency. Vitamin A must be administered immediately according to the three-dose schedule in Table 1. In order to treat or reduce the risk of secondary bacterial or viral (measles) infection of the eye, which would compound the damage to the cornea, the topical application of an antibiotic eye ointment, such as tetracycline or chloramphenicol, is recommended. Ophthalmic ointment containing steroids should never be used in this situation. To prevent trauma to a cornea already weakened by xerosis or ulceration, the eye should be protected by an eye shield (not occlusive), and it may be necessary to restrain the arm movements of young children by light bandaging.

Women of reproductive age, pregnant or not

For night blindness or Bitot’s spot, treat with a daily dose of 10,000 IU of vitamin A orally (1 sugar-coated tablet) for 2 weeks.

When active corneal lesions of xerophthalmia occur in a woman of reproductive age, one has to balance the possible teratogenic or other risk to the foetus (should she be pregnant) of a large dose of vitamin A against the serious consequences for her of vitamin A deficiency if she is not given a large dose. It would appear reasonable, in these exceptional circumstances, to administer the full treatment for corneal xerophthalmia, as described above for young children.
Vitamin A Supplements: Prevention of Vitamin A Deficiency

Universal-Distribution Prevention Schedule for preschool children and lactating mothers.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Vitamin A Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children over 1 year and under 6 years old.</td>
<td>200,000 IU orally every 3-6 months.</td>
</tr>
<tr>
<td>Infants 6-12 months old</td>
<td>100,000 IU orally every 3-6 months.</td>
</tr>
<tr>
<td>any older children who weigh less than 8kg</td>
<td>Immunisation against measles provides a good opportunity to give one of these doses (see Note).</td>
</tr>
<tr>
<td>Lactating mothers</td>
<td>200,000 IU orally once; at delivery or during the next 2 months. This will raise the concentration of vitamin A in the breast milk and therefore help to protect the breast-fed infant.</td>
</tr>
</tbody>
</table>

Note: When infants less than 6 months old are not being breast-fed, supplementation with 50,000 IU of vitamin A before they reach 6 months should be considered.

Steps in Assessing and controlling vitamin A deficiency.

Control
- Nutrition Improvement
- Diarrhoea control

Activities
- Measles immunisation
- Capsules to high risk groups

Assessment
- Consider population survey
- Look at hospital records
- Examine Blind School

Time
The Glaucomas
Definitions and Classifications

Definition
The Glaucomas are a group of diseases which have in common, characteristic damage of the optic nerve (pathological cupping and optic atrophy), resulting in loss of vision (visual field then visual acuity), which is often but not always associated with raised intra-ocular pressure.

Simple Classification
1. Congenital*
2. Primary angle closure
3. Primary open angle
4. Secondary
   * Congenital glaucoma (buphthalmos) is relatively rare.

Various Classifications
1. Aetiological
   1.1 Primary - cause unknown
   1.2 Secondary - to another disease e.g. trauma, uveitis
2. Clinical
   2.1 Acute - sudden painful onset with a red eye
   2.2 Chronic - gradual loss of vision in a white eye
3. Patho-physiological
   3.1 Increased secretion - may occur in uveitis
   3.2 Decreased drainage
      3.2.1 Pupil block, e.g. occlusio pupil
      3.2.2 Angle block e.g. primary angle closure glaucoma (PACG)
      3.2.3. Trabecular block e.g. primary open angle glaucoma (POAG)

Magnitude
Global Prevalence of Glaucoma 1990
(W.H.O programme for Prevention of Blindness)

<table>
<thead>
<tr>
<th>Type</th>
<th>Cases</th>
<th>Blind</th>
</tr>
</thead>
<tbody>
<tr>
<td>POAG</td>
<td>13.5 million</td>
<td>3.0 million</td>
</tr>
<tr>
<td>PACG</td>
<td>6.0 million</td>
<td>2.0 million</td>
</tr>
<tr>
<td>Congenital</td>
<td>0.3 million</td>
<td>0.2 million</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.7 million</td>
<td>Unknown</td>
</tr>
<tr>
<td>Total</td>
<td>22.5 million</td>
<td>5.2 million (15% global blind)</td>
</tr>
</tbody>
</table>

(A study by Harold A. Quigley MD (Br J Ophthalmol 1996; 80: 389-393) estimates glaucoma worldwide by the year 2000 AD as affecting 66.8 million people with 6.7 million blind)
Prevalence of POAG

<table>
<thead>
<tr>
<th>Age</th>
<th>UK USA</th>
<th>AFRICA CARIBBEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 40</td>
<td>Rare</td>
<td>0.5%</td>
</tr>
<tr>
<td>40s +</td>
<td>1%</td>
<td>2-3%</td>
</tr>
<tr>
<td>50s +</td>
<td>2%</td>
<td>5-6%</td>
</tr>
<tr>
<td>60s +</td>
<td>3%</td>
<td>6-10%</td>
</tr>
</tbody>
</table>

Distribution of 13.5 million cases of POAG Worldwide

<table>
<thead>
<tr>
<th>Region</th>
<th>%</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>20%</td>
<td>= 2.5 million cases</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>20%</td>
<td>= 2.5 million cases</td>
</tr>
<tr>
<td>Western World</td>
<td>18%</td>
<td>= 2.5 million cases</td>
</tr>
<tr>
<td>India</td>
<td>13%</td>
<td>= 2 million cases</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>7%</td>
<td>= 1 million cases</td>
</tr>
<tr>
<td>Middle East</td>
<td>5%</td>
<td>= 0.5 million cases</td>
</tr>
<tr>
<td>East Asia/Pacific</td>
<td>10%</td>
<td>= 1.5 million cases</td>
</tr>
<tr>
<td>Latin America</td>
<td>7%</td>
<td>= 1.0 million cases</td>
</tr>
</tbody>
</table>

Risk Factors for the Glaucomas

**Primary Open Angle Glaucoma**

1. Age (increasing 4-5x from 40 to 70yrs)
2. Race (Blacks 3-4x more likely than Whites)
3. Family History (positive family history 5x more likely)
4. Intraocular pressure (IOP over 20mms 5x more likely)
5. Many others but less important

**Primary Angle Closure Glaucoma**

1. Age
2. Race Eskimos +++; Chinese ++; Blacks rare)
3. Females (females 3-4x more common than males)
4. Hypermetropia
5. Shallow anterior chamber (<2.5mm)
Control – Screening and Case Detection

A major problem in reducing visual loss and blindness from The Glaucomas is that most people do not know they have the disease, and many present late when they have already lost a great deal of vision in one or both eyes. It would therefore be helpful if we could identify people with glaucoma at a relatively early stage so that treatment could be started before much vision has been lost. The word “Screening” is used in public health when referring to the examination of a population at risk for a disease with a relatively simple test. “Case detection” is used to refer to the opportunistic examination of people for disease when they present for a medical/eye examination.

### Diagnosis of POAG

1. There are 3 classical features of POAG
   - A. Raised IOP (25% to 50% can have normal pressure)
   - B. Pathological cupping optic nerve head
   - C. Typical visual field loss
2. The later (more advanced) the disease, the easier the diagnosis
3. The later (more advanced) the disease, the greater the visual loss
4. No one test is sufficient in early cases to diagnose the disease
5. Loss of vision is usually slowly progressive in both eyes, but usually one eye is more affected than the other. Patients therefore present late. The time of presentation depends on the availability of eye care services.

### Screening

**Ten needs to be considered before starting a Screening programme**

#### Disease

1. The condition should be an important public health problem
2. There should be a recognisable latent stage
3. The natural history of the disease should be adequately understood

#### Test

4. There should be a valid screening test in terms of sensitivity and specificity
5. The test should be acceptable to the population

#### Treatment

6. There should be an accepted treatment
7. There should be an agreed policy on whom to treat
8. Facilities for diagnosis and treatment should be available

#### General

9. Cost effectiveness and opportunity cost should be considered
10. Case finding should be an on going process

### Exercise: 1

Consider various eye diseases. Do they meet the criteria for screening?

* e.g. macular degeneration, diabetic retinopathy, myopia, Vitamin A Deficiency, onchocerciasis, trachoma, amblyopia, cataract, glaucoma, poor vision.


**Sensitivity/Specificity and Positive Predictive Values**

In order to decide how good a test is at identifying patients in a population as having the disease, or being normal, one can measure the sensitivity, specificity, and positive predictive value.

<table>
<thead>
<tr>
<th>DISEASE +VE</th>
<th>DISEASE -VE</th>
<th>Totals</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>+VE TEST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>A + B</td>
<td>A = True Positive</td>
</tr>
<tr>
<td>-VE TEST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>D</td>
<td>C + D</td>
<td>B = False Positive, C = False Negative</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A + C</td>
<td>B + D</td>
<td>Total</td>
<td>D = True Negative</td>
</tr>
</tbody>
</table>

- **Sensitivity** = Probability of a Diseased Person having a Positive Test
  Or
  **Detection Rate** = \[
  \frac{A}{A + C}
  \]

- **Specificity** = Probability of a Normal Person having a Normal Test
  Or
  **True Normal Rate** = \[
  \frac{D}{B + D}
  \]

- **Positive Predictive Value** = Probability of a Positive Test having the Disease
  \[
  \frac{A}{A + B}
  \]

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>Present</th>
<th>Absent</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Positive</td>
<td>True Positive</td>
<td>False Positive</td>
<td></td>
</tr>
<tr>
<td>Test Negative</td>
<td>False Negative</td>
<td>True Negative</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>
### Exercise 2:

<table>
<thead>
<tr>
<th></th>
<th>Glaucoma Positive</th>
<th>Glaucoma Negative</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOP &gt;21mm</td>
<td>10</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>Positive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IOP &lt;21mm</td>
<td>10</td>
<td>890</td>
<td>900</td>
</tr>
<tr>
<td>Negative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>20</td>
<td>980</td>
<td>1000</td>
</tr>
</tbody>
</table>

1. How many people have glaucoma? What is the prevalence?
2. How many cases of glaucoma did the test for an IOP of over 21 detect? What is the sensitivity of the test?
3. How many people had an abnormal test? How many of these had glaucoma? What is the positive predictive value of the test?
4. What will happen if optometrists or ophthalmic assistants implement this screening test in the community?

### Points to consider:
- In recent surveys, more than half the newly detected cases of glaucoma had a normal pressure at the time of screening.
- In recent surveys, at least half the cases of POAG were not previously diagnosed.
- At present no one test for glaucoma is simple, sensitive and specific.

### Alternative Screening Tests in the Community

### Exercise 3
Consider each of these tests for glaucoma.
Give a grade 5 for very good and 1 for very poor
Grade each test for diagnosing glaucoma for use at the primary community level.

<table>
<thead>
<tr>
<th>Method</th>
<th>Sensitivity/Specificity</th>
<th>Feasibility</th>
<th>Reproducibility</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOP (Applanation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IOP (Schiotz)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ophthalmoscopy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perimetry (Manual)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perimetry (Computer)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Case Detection of POAG in a Community

In practice to detect cases of undiagnosed glaucoma in a clinic most eye specialists use clinical judgement involving two tests, namely:

a) measurement of intra-ocular pressure (IOP)

b) assessment of the optic disc, particularly the ratio of the cup to the disc vertical diameter (C/D)

If there is a suspicion of glaucoma based on either of these two tests then further investigations are performed including visual field examination by perimetry.

**Vertical Cup/Disc Ratio**

- **‘Suspect’**
- **‘Case’**
- **‘Safe’**
- **‘Suspect’**

**Step 1.** ASSESS CUP: DISC RATIO

- ?<0
- ?≥0.6

**Step 2.** MEASURE IOP

- ‘Normal’ ?< 28 (Schiotz tonometer)
- ? ≥28 ‘Suspicious’
- ?<28
- ?>28 ‘Case’

**Step 3.** Confirm diagnosis with perimetry

**Step 4.** Treat and follow-up
Control – Treatment of Chronic Glaucoma

Principle of Treatment
The aim of glaucoma treatment is to stop further visual loss. Glaucoma treatment does not (usually) restore or improve vision.

The treatment aims is to reduce the “high” intra-ocular pressure, which is believed to reduce blood flow to the optic nerve head. This reduced blood perfusion of the optic nerve head damages the nerve cells in the retina resulting in progressive visual field loss.

There is no IOP which can be considered safe for all people. The “safe” IOP has to be estimated for each glaucoma patient and treatment targeted at achieving that IOP so that no further optic nerve damage will occur.

Research work is also looking at medicines to improve the blood flow to the optic nerve or protect the nerve cells from damage due to low blood perfusion.

Possible Strategies

1. Medical therapy
   Medical therapy is for life.
   It is therefore relatively expensive.
   Many patients particularly in rural areas cannot access the medicines.
   Many patients forget / stop to take their medicines as they see no improvement in vision.

   1.1. Drops reducing aqueous production
       * Beta blockers eg. timolol, betaxolol
       * Alpha agonists eg. propine, brimonidine
       * Carbonic anhydrase inhibitor eg. trusopt

   1.2. Drops increasing aqueous outflow
       * Cholinergic eg. Pilocarpine
       * Prostaglandin analogues eg. Latanaprost.

2. Laser trabeculoplasty
   Usually argon laser applications to the trabecular meshwork in POAG.
   This tends to be reserved for elderly patients who cannot undergo surgery and have poor compliance with long-term medications.
   Other laser therapies to the ciliary body to reduce aqueous secretion are also being used.
   Laser iridotomy is the treatment and prophylaxis used in primary angle closure glaucoma.

3. Filtration surgery
   There are various forms of surgery to cause filtration of fluid out of the eye. They may also be used with chemical agents which reduce scarring at the operation site (anti-metabolites).
   The commonest procedure is called Trabeculectomy.
   Patients are afraid of eye surgery, particularly on a “seeing” eye.
Each strategy therefore has its advantages and disadvantages.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>‘Easy’ for doctor</td>
<td>Patient compliance often poor</td>
</tr>
<tr>
<td></td>
<td>‘Easy’ for patient</td>
<td>Cost high</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Efficacy uncertain</td>
</tr>
<tr>
<td>Laser</td>
<td>Satisfactory for doctor</td>
<td>Efficacy wears off</td>
</tr>
<tr>
<td></td>
<td>Satisfactory for patient</td>
<td>Laser is required</td>
</tr>
<tr>
<td>Surgery</td>
<td>One time treatment</td>
<td>‘Difficult’ for doctor</td>
</tr>
<tr>
<td></td>
<td>Best efficacy</td>
<td>‘Difficult’ for patient</td>
</tr>
</tbody>
</table>

**Evidence for Treatment**

The following 3 clinical trials compare the efficacy of treatment.

1. **The Redmond Smith Study (1986)**
   Comparison of primary medical versus primary surgical groups for 54 mths. follow-up.
   
   **Conclusions:**
   1. Lower IOP with surgery: mean values 17mms v 22mms.
   2. Less field loss with surgery after 3½ yrs follow-up.
   3. No significant difference in visual acuities


2. **The Jay Allen Study (1989)**
   Comparison of primary medical versus primary surgical treatment; mean follow-up time 54 months
   
   **Conclusions:**
   **Less visual field loss with primary surgery (p= 0.027)**


   Comparison of primary medical versus primary surgical versus primary laser treatment.
   
   **Conclusions:**
   1. Primary surgery gives lower IOP
   2. Primary surgery gives greater success by 3y.
   3. No significant difference in visual acuity

Community Programme to Reduce Blindness from Glaucoma

The management of clinical glaucoma in a hospital or clinic setting is quite different from trying to reduce visual loss from glaucoma in a public health setting as part of a comprehensive eye care programme.

The principles of developing a community programme to reduce blindness from glaucoma are as follows:

1. Assess the magnitude and types of glaucoma in the community. This may be a population based survey or estimates based on previous surveys and hospital data from the population being served.

   e.g. for a population of 1 million people, the at risk population is those aged over 40 years, which is approximately 25% = 250,000. The prevalence rate over 40 years is 1% - 2% = 2500 - 5000 cases.

   For black populations the population at risk is younger and the overall prevalence higher giving approximately 6000 – 10000 people with POAG in black populations. These are crude estimates.

2. The people with glaucoma can usefully be divided into groups according to the degree of visual loss:
   - early
   - moderate
   - late
   - too late for sight preserving treatment

   The actual definitions for these groupings may vary from situation to situation.

3. The priority for a community programme for glaucoma is to reduce the number of people in a population who end up with too late and late disease.

   This means
   - definitely finding those with late,
   - trying to identify those with moderate
   - possibly finding some patients with early disease in the community so that they can be treated.

   e.g. of the on average 5000 cases/million pop, some have early glaucoma, and 10% are already blind, so that maybe 50% have moderate or late, detectable and treatable glaucoma. This is the priority target group for community case detection. It is estimated at between 2000-4000 patients per million population.

4. The case detection is most usefully performed on people over 40 years of age. This age group may present to an eye clinic needing reading spectacles. This is a good opportunity to check the optic disc and measure the IOP. If either are suspicious then visual field examination can be considered.

5. Treatment at present is to lower IOP. There is no universal “safe” IOP. Each patient is unique. A target IOP should be set for each patient and then treatment given to achieve that IOP. In deciding whether to use medicines, laser or surgery, consideration must be given to the patient’s ability to pay and comply with treatment and the likelihood of the patient coming for follow up examinations.
Diabetic Retinopathy
Diabetic Retinopathy

Definition
Older descriptive terms have been substituted by new terminology from the Early Treatment Diabetic Retinopathy Study (ETDRS) (see table)

Classification

<table>
<thead>
<tr>
<th>Diabetic Retinopathy</th>
<th>New Term (ETDRS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old Descriptive Term</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>Mild Non-</td>
</tr>
<tr>
<td></td>
<td>Moderate Non-</td>
</tr>
<tr>
<td>Pre-Proliferative</td>
<td>Severe Non-</td>
</tr>
<tr>
<td></td>
<td>Very Severe</td>
</tr>
<tr>
<td>Proliferative</td>
<td>Proliferative</td>
</tr>
<tr>
<td>Maculopathy</td>
<td>Maculopathy</td>
</tr>
<tr>
<td>diffuse</td>
<td>(therapy based on “Clinically</td>
</tr>
<tr>
<td>exudative</td>
<td>Significant Macular Oedema”)</td>
</tr>
<tr>
<td>ischaemic</td>
<td></td>
</tr>
</tbody>
</table>

Clinical Features, Natural History and Management

<table>
<thead>
<tr>
<th>Level of Retinopathy</th>
<th>Clinical Features</th>
<th>Natural History</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rate of</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>progression to</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PDR at 1 year</td>
<td></td>
</tr>
<tr>
<td>Mild non-proliferative</td>
<td>More than 1</td>
<td>5%</td>
<td>Review 12</td>
</tr>
<tr>
<td></td>
<td>microaneurysm</td>
<td></td>
<td>mths</td>
</tr>
<tr>
<td>Moderate non-proliferative</td>
<td>Haemorrhage and</td>
<td>25%</td>
<td>Review 6</td>
</tr>
<tr>
<td></td>
<td>microaneurysms in 1-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>quadrants; cotton</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>wool spots, venous</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>beading and IRMAs</td>
<td></td>
<td>mths</td>
</tr>
<tr>
<td>Severe non-proliferative</td>
<td>Haemorrhage,</td>
<td>50%</td>
<td>Review 3</td>
</tr>
<tr>
<td></td>
<td>microaneurysms in</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>all quadrants; or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>venous beading in</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>more than 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>quadrants; or IRMA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>in 1 quadrant</td>
<td></td>
<td>mths</td>
</tr>
<tr>
<td>Proliferative</td>
<td>Neovascularisation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinically Significant</td>
<td>Maculopathy with visual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macula Oedema</td>
<td>acuity deterioration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ref: Journal of Community Eye Health, Volume 9, Issue No.20, 1996, Page 59
Magnitude

- There is an increase in diabetes mellitus throughout the world.
- Diab. Retinopathy accounts for 5-10% of all blindness in economically ‘intermediate’ countries
- It is becoming increasingly important in developing countries.

Prevalence

- Diabetic Retinopathy is associated with increased mortality.
- Prevalence of diabetes mellitus (I & II) = 3% -5%
  \( = 30,000 – 50,000 \text{ diabetics/million population}.\)
- Prevalence of any retinopathy in diabetics = 20%
  \( = 6,000 – 10,000 \text{ with diabetic retinopathy/million population}.\)
- Prevalence of blindness among these is 5%
  \( = 300 - 500 \text{ blind/million population i.e., 5% all blindness}.\)

Incidence

- Of the total population in the USA, 0.03% are new cases of diabetic macular oedema.
- Of the total population of the USA, 0.02% are new cases of proliferative retinopathy.
- Therefore in the USA, 0.05% of the population develop sight threatening retinopathy per year. That is, 500 people/million population/year

Aetiology

Risk Factors for Diabetes Mellitus

- age
- sex (F>M)
- obesity
- family history

Risk Factors for Diabetic Retinopathy

- age/duration of diabetes
- nephropathy (proteinuria)/neuropathy
- hypertension
- pregnancy
- glycaemic control
- ethnic/genetic determinants
- smoking antioxidants

Control

Screening for Diabetic Retinopathy

- **Who?** Ophthalmologist/optometrist/ ophthalmic assistant/ specifically trained general doctors
- **How?** Fundoscopy and/or photo, using ophthalmoscope and/or camera
- **When?** Type 1 yearly after 5 years
  Type 2 at diagnosis and then yearly
## Treatment of Diabetic Retinopathy

<table>
<thead>
<tr>
<th>Type</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild/moderate non-proliferative ('background')</td>
<td>Nil</td>
</tr>
<tr>
<td>Circinate (lipid) maculopathy</td>
<td>Focal laser to centre of circinate (unless at fovea)</td>
</tr>
<tr>
<td>Clinically significant macular oedema ('diffuse')</td>
<td>Soft grid laser 50 micron</td>
</tr>
<tr>
<td>'Dry ischaemic' maculopathy</td>
<td>Nil</td>
</tr>
<tr>
<td>Proliferative retinopathy/ Disc neovascularisation</td>
<td>Pan-retinal laser treatment 1500-2000 x 500 micron</td>
</tr>
<tr>
<td>Proliferative retinopathy 'elsewhere'/peripheral neovascularisation</td>
<td>Pan-retinal laser treatment 1500-2000 x 500 micron</td>
</tr>
<tr>
<td>Vitreous haemorrhage</td>
<td>Vitrectomy</td>
</tr>
<tr>
<td>Tractional/Rhegmatogenus* retinal detachment</td>
<td>Vitrectomy/ Retinal detachment surgery</td>
</tr>
<tr>
<td>Non-responsive proliferative diabetic retinopathy</td>
<td>Vitrectomy</td>
</tr>
</tbody>
</table>

### Exercise:

As programme managers, you have the task of organising a programme to deal with Diabetic Retinopathy for a population of 1 million people. How do you plan to do this?

How would you increase the number of patients seen and needing treatment?

Estimate:

- the number of people needing treatment
- the number of treatments per year
- the time taken, people and equipment needed
Progression of Proliferative Diabetic Retinopathy

Diabetic Retinopathy Study (DRS) Visual Outcome:
Severe Visual Loss**

Severe visual loss defined as 5/200 or less - 2 or more consecutive visits

<table>
<thead>
<tr>
<th>Severity of Retinopathy</th>
<th>Duration of Follow-up (years)</th>
<th>Control Patients (%)</th>
<th>Treated Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-proliferative</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>mild proliferative</td>
<td>2</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>high-risk proliferative</td>
<td>2</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>28</td>
<td>12</td>
</tr>
</tbody>
</table>

Conclusion:
Treatment reduces severe visual loss by (65%-75%)

Progression of Diabetic Macular Oedema

EDTRS Visual Outcome:
Visual Loss = Doubling of the Visual Angle

<table>
<thead>
<tr>
<th>Severity of Retinopathy</th>
<th>Duration of Follow-up (years)</th>
<th>Control Patients (%)</th>
<th>Treated Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSMO* (centre of macula not involved)</td>
<td>1</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>CSMO (centre of macula involved)</td>
<td>2</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33</td>
<td>14</td>
</tr>
</tbody>
</table>

* clinically significant macular oedema

Conclusion:
Treatment reduces visual loss by 50% - 75%
Diabetic Retinopathy: Summary

1,000,000 population

Population at risk diabetics: prevalence. 3% = 30,000

Non-insulin dependent diabetes mellitus
Insulin dependant diabetes mellitus

Screening at diagnosis and then every year

Normal fundus

Abnormal fundus

Diagnosis by Ophthalmologist

Normal fundus

Background diabetic retinopathy

Treatable maculopathy

Proliferative diabetic retinopathy

Vitreous haemorrhage or retinal detachment

Routine annual screen

Follow-up by ophthalmologist

Laser and follow-up

Pan retinal treatment + follow-up

Vitrectomy + follow-up

High risk of maculopathy or proliferative diabetic retinopathy

Loss of central vision without treatment

Without treatment 300-500 blind/million population

500 cases/

Screening at 5 years after diagnosis and then annually

76
Trachoma
1. Definition

- a chronic granulomatous keratoconjunctivitis
- essential cause is Chlamydia trachomatis
- transmitted under conditions of poor hygiene
- inflammation leads to scarring, resulting in trichiasis and entropion

1.1 The Organism:

Chlamydia are closer to bacteria than viruses.
They are obligate intracellular organisms.
They have cell walls.
They have both DNA and RNA, and multiply by binary fission.
They are sensitive to some antibiotics.

![Chlamydia Organism Diagram]

- Chlamydia
  - C. trachomatis
    - humans
    - Trichoma
      - ABC
      - D-K
      - Genital infections
  - C. psittaci
    - animals
    - LGV agent
      - Li, 2, 3
      - Serotypes
    - Lymphogranuloma venereum
2. Magnitude

It is estimated that:

- 150 million children have active infection (TF or TI).
- 300 million people have evidence of scarring showing old disease (TS).
- 30 million people have potentially blinding trichiasis (TT).
- 5 million people are bilaterally blind (blinding CO).

3. Aetiology

3.1. Transmission of trachoma

In trachoma, the severity of inflammation is directly associated with the frequency of repeated re-infection. The frequency of re-infection depends on the factors which promote transmission.

The factors which favour transmission are:

A community environment which is:
- DRY - lack of water.
- DUSTY - lack of water
- DIRTY/DUNG - exposed animal/human faeces

A family environment which has:
- DISCHARGES - ocular (including seasonal conjunctivitis)
  - nasal and possibly genital.

The agents of transmission are:
- FLIES
- FOMITES
- FINGERS

This transmission is occurring mainly within the
- FAMILY or among close
- FRIENDS
4. Control

There are two parts to “Control”- assessment and then management

4.1 Assessment

4.1.1 WHO GRADING OF TRACHOMA

TRACHOMA FOLLICULAR (TF)
There are 5 or more follicles in the upper tarsal conjunctiva.
(For this grading system, follicles must be at least 0.5mm in diameter)

TRACHOMATOUS INFLAMMATION, INTENSE (T1)
Pronounced inflammatory thickening of the tarsal conjunctiva will obscure half
the normal deep tarsal vessels.

TRACHOMATOUS CONJUNCTIVAL SCARRING (TS)
The presence of scarring in the tarsal conjunctiva.
(These scars are easily visible as white lines, bands or sheets [fibrosis] in the
tarsal conjunctiva.)

TRACHOMATOUS TRICHIASIS (TT)
At least one eyelash rubs on the eyeball.
(Evidence of recent removal of intumed eyelashes should also be graded as
trichiasis.)

CORNEAL OPACITY (CO)
Easily visible corneal opacity is present over the pupil.
(This definition refers to corneal scarring which is so dense that at least part of
the pupil margin is blurred when seen through the opacity.)
4.2 Management
The SAFE strategy

S  Surgery for trichiasis

A  Antibiotics for active infection
   oc. tetracycline 1% x 2 for 6 weeks
   or
   azithromycin 1 dose by mouth stat

F  Facial cleanliness through health education

E  Environmental improvement with water and sanitation
Planning a VISION 2020 Programme
Planning a VISION 2020 Programme

The Concept

YOU ARE HERE       YOU WANT TO BE HERE

1 DECIDING WHERE YOU ARE = SITUATIONAL ANALYSIS
OF NEED AND RESOURCES

2 DECIDING WHERE YOU WANT TO BE = AIM, PRIORITIES,
OBJECTIVES

3 DECIDING HOW TO GET THERE = PLAN, TIMETABLE AND
BUDGET

4 GETTING THERE = MANAGEMENT OF RESOURCES AND
MONITORING

Need 1 Plan 5 Management 7 Aim 3

2 Resources 6 Timetable

Monitoring 8 Objectives 4
1. Assess Need

TARGET THE POPULATION

The population to be served must be defined.

MAP

The distribution of the population and characteristics of the area/geography should be known.

PREVALENCE AND CAUSES OF EYE DISEASE AND BLINDNESS

Estimate the prevalence, incidence and major causes of eye disease and blindness from survey data.

2. Assess Resources and Utilisation

MANPOWER

MATERIALS

MOBILITY

MANAGEMENT

MONEY

2.1. MANPOWER

2.1.1. Primary Level - Clinic Nurses
The number recommended is 1 per 10 000 population.
At least 1 clinic nurse in each residential clinic should be trained in primary eye care.

2.1.2. Secondary Level - Eye Nurses
The number recommended is 1 per 100 000 population.
At least 1 registered nurse in each district should be trained as an eye nurse.

2.1.3. Secondary Level - Optometrists
The number recommended is 1 per 250 000 population.
There should be at least 1 graduate optometrist in each region.
In addition, it is recommended that optometrists working in eye care programmes undergo a 3 month clinical / practical orientation at the regional eye clinic.

2.1.4. Tertiary Level - Ophthalmic Medical Officers / Ophthalmologists
The number recommended is 1 ophthalmic medical officer per 250 000 population and 1 ophthalmologist per 500 000 population.
There should be at least 1 ophthalmic medical officer or ophthalmologist in each region.
The training for an ophthalmic medical officer is a 6 month post-graduate training, leading to a diploma qualification in ophthalmology.
The training for an ophthalmologist is a 4 year post-graduate training, leading to a fellowship qualification in ophthalmology.
2.2. MATERIALS

2.2.1. Hard Materials (Instruments And Equipment)

Primary level –
The instruments and equipment recommended for the clinic nurses for primary eye care are:
Snellen chart
Torch.

Secondary level –
The instruments and equipment recommended for the eye nurses for secondary eye care are:
Snellen chart, reading card
Trial lens set, trial frame, cross cylinder, retinoscope
Direct ophthalmoscope
Schiotz tonometer.

Tertiary level -
The instruments and equipment recommended for the ophthalmic medical officers / ophthalmologists for tertiary eye care are:
Snellen chart, reading card
Trial lens set, trial frame, cross cylinder, retinoscope
Autorefractor
Direct ophthalmoscope
Indirect ophthalmoscope, 20D lens
Slit lamp, applanation tonometer
Gonioscopy lens, fundoscopy lens
Argon laser
Yag laser
Operating microscope
Microsurgical instruments x 2 sets
Hot air steriliser
Anterior vitrectomy - phacoemulsification unit.

2.2.2. Soft Materials (Drugs And Surgical Consumables)

The drugs required at the clinics, district hospitals, and regional hospital are according to the Essential Drug Lists.
The surgical consumables required at the regional hospital for (cataract) surgery are:
Blades
Cauterries
Intraocular lenses
Pads
Shields
Sponges
Sutures 4-0 silk + 10-0 nylon.
2.3. MOBILITY

The eye nurses require transport to get to their district clinics. It is usually not possible for a vehicle in each district to be allocated wholly to the eye care programme. Transport should be shared with the other programmes in the district.

2.4. MANAGEMENT

The regional eye care programme should be managed by an eye care programme committee.

2.4.1. Functions of the Committee
Planning of the regional eye care programme
Mobilisation of resources for the programme
Implementation of activities of the programme
Evaluation of the progress and results of the programme.

2.4.2. Structure of the Committee
It should be small and active.
It should meet 3 or 4 times each year.
It should comprise representatives from -
Regional and district health management
Eye care professionals (eye nurses, eye doctors)
Community (traditional healers, community leaders)
Local NGOs / service organisations.

2.5. MONEY

The eye care programme should be a horizontal programme, integrated into the regional and district health services. There would therefore be no specific budget allocated for it. However, it still has a cost. Provision should be made in the regional / district budget for eye care / blindness prevention activities.

2.6. CURRENT EYE CARE AND BLINDNESS PREVENTION ACTIVITIES

Identify what eye care and blindness prevention activities are currently happening in the region at the primary, secondary, and tertiary levels.
3. Define the Aim
Prevention of Blindness
It may or may not have a final goal.

4. Specify the Objectives
They should be measurable and time limited.
They may include the following:

1. Human Resource Development: primary, secondary and tertiary
2. Mobilisation / Utilisation of Resources
3. Cataract services
4. Control of ocular infections
5. Prevention of eye disease in children
6. School Screening and refractive errors

5. Define the Priorities and Strategy
The strategies for disease control, human resource development and provision of infrastructure need to be defined.
It is important to understand the needs of the community and the existing services.
6. Prepare a Timetable
List the activities that are necessary to reach each of the objectives. Prepare a timetable showing each of these activities, indicating when they will be undertaken and when they will be completed.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
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<tbody>
<tr>
<td></td>
<td>Jan</td>
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<tr>
<td>examples. planning meetings</td>
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<td>training</td>
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<td>mid-level</td>
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<td>ordering equipment</td>
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<td>train PECW</td>
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<td>out-reach clinics</td>
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</table>

7. Prepare a Budget
The eye care programme is a horizontal programme integrated into the regional and district health services. There is no specific budget allocated for it. However, it is necessary to be able to present a budget for the programme to the regional management.

Prepare a budget → Expenditure and Income

EXPENDITURE: a) capital (one time)
b) running (recurrent)

INCOME: a) fees
b) government grants
c) local support
d) international donors
8. Management
Form a Project committee and if possible appoint a manager/administrator.
Monitor resource utilisation for efficiency.

The two main resources to “look after” are money and more importantly “people.”

9. Monitoring
Keep and analyse Specific Statistics to monitor progress and achieve the objectives.
For example:

- Number of outpatients seen
- Quantity of cataracts
- Quality of surgery - visual outcome
- Cost of surgery
- Trachoma statistics
- Vitamin A deficiency statistics
- Refractive errors / spectacles

Assessing needs, resources and priorities will enable you to plan your aim, objectives and strategy. This is necessary for effectiveness, i.e. doing the right thing.

Making a timetable of activities / targets and managing your resources (time, people, money) will improve efficiency, i.e. doing things in the right way.

A good programme is both effective and efficient.

Planning Committee
A Planning Committee may be at:

* National level
* Provincial level
* Project level

Functions of the Committee
1. Plan a PBL / eye care programme
2. Mobilise resources / Funding for the programme
3. Implement activities
4. Evaluate progress and results

Structure of the Committee
1. Small and active
2. Members from
   - Ministry of Health
   - Public health
   - Ophthalmology / eye care services
   - Community
   - Local NGO/Service Organisation
   - Possibly Intern Non-Governmental Development Orgs.
   - Possibly United Nations (UN) agencies
A Prevention of Blindness (PBL) Programme
Should:-
1. Meet communities’ needs (not the providers interests alone).
2. Be continuous and sustainable (not a one time event).
3. Be comprehensive (to deal with important eye problems, not one specific disease).

Outline Proposal For Funding A Specific One Time Request

<table>
<thead>
<tr>
<th>Summary</th>
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<tbody>
<tr>
<td>What are you requesting?</td>
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<tr>
<td>Why are you making the request?</td>
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<td>What will it cost?</td>
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<table>
<thead>
<tr>
<th>Background Information to the Project</th>
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<tbody>
<tr>
<td>Country</td>
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<tr>
<td>Project</td>
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<tr>
<td>Statistics</td>
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<table>
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<tr>
<th>Rationale</th>
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<tbody>
<tr>
<td>Why do you need this?</td>
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<tr>
<td>What will it help you to do?</td>
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<tr>
<td>How will patients benefit?</td>
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<table>
<thead>
<tr>
<th>Budget</th>
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<tr>
<td>Give specifications and estimated cost or proforma invoice</td>
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<tr>
<th>Local Support</th>
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<tbody>
<tr>
<td>Address</td>
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<tr>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>American Academy of Ophthalmology</strong></td>
</tr>
<tr>
<td>International Committee</td>
</tr>
<tr>
<td>655 Beach Street</td>
</tr>
<tr>
<td>Box 7424</td>
</tr>
<tr>
<td>San Francisco</td>
</tr>
<tr>
<td>USA CA94120-7424</td>
</tr>
<tr>
<td>FAX: 1 415 561 8533</td>
</tr>
<tr>
<td><strong>Fred Hollows Foundation</strong></td>
</tr>
<tr>
<td>Box 561,</td>
</tr>
<tr>
<td>Kathmandu</td>
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<tr>
<td>Nepal</td>
</tr>
<tr>
<td>Fax 00977.1.474937</td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>International Centre for Eye Health</strong></td>
</tr>
<tr>
<td>Bath Street</td>
</tr>
<tr>
<td>London</td>
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<tr>
<td>EC1V 9EL</td>
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<tr>
<td>UNITED KINGDOM</td>
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<tr>
<td>FAX: 44 171 250 3207</td>
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<tr>
<td><strong>Lions Club International</strong></td>
</tr>
<tr>
<td>300 22nd Street</td>
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<tr>
<td>Oak Brook</td>
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<tr>
<td>Illinois 60521-8842</td>
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<tr>
<td>FAX: 1 708 571 8890</td>
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<tr>
<td><strong>ORBIS</strong></td>
</tr>
<tr>
<td>330 West 42nd Street</td>
</tr>
<tr>
<td>Suite 1900</td>
</tr>
<tr>
<td>New York 10036</td>
</tr>
<tr>
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<tr>
<td>FAX: 1 212 244 2744</td>
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<tr>
<td><strong>World Health Organisation</strong></td>
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<tr>
<td>Prevention of Blindness Programme</td>
</tr>
<tr>
<td>1211 Geneva 27</td>
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<tr>
<td>SWITZERLAND</td>
</tr>
<tr>
<td>FAX: 41 22 791 0743</td>
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