GHANA
Cataract
A GROWING PROBLEM

Between 1975 and 1995 WHO reported increase in blindness
- 28 to 45 million people
- Headed towards > 75 million in 2020

Most of them have lost their sight to preventable or treatable causes

80% live in lesser developed countries
Blindness is more common in poor countries

blind per million population
<table>
<thead>
<tr>
<th>Cause</th>
<th>%</th>
<th>Trend</th>
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<tbody>
<tr>
<td>CATARACT</td>
<td>50</td>
<td>INCREASING</td>
</tr>
<tr>
<td>REFRACTIVE ERRORS</td>
<td>10</td>
<td>INCREASING</td>
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<tr>
<td>GLAUCOMA</td>
<td>10</td>
<td>INCREASING</td>
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<tr>
<td>DIABETIC RETINOPATHY</td>
<td>5</td>
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<td>AMD and OTHER DISEASES</td>
<td>10</td>
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<tr>
<td>TRACHOMA/ INFECTIVE SCAR</td>
<td>12</td>
<td>DECREASING</td>
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<tr>
<td>ONCHOCERCIASIS</td>
<td>2</td>
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<tr>
<td>VITAMIN A DEFICIENCY</td>
<td>1</td>
<td>DECREASING</td>
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</tbody>
</table>
6 billion

1.5 bil
Very Poor
25m blind
Infections
Cataract

1.5 bil
Poor
12 m blind
Cataract
Glaucoma

1.5 bil
OK
8 m blind
Cataract
Glaucoma

1.5 bil
Good
5 m blind
Glaucoma
Retina Dis
Global Blindness

BLIND (millions)
What is Vision 2020?

- A joint program to eliminate preventable blindness worldwide by the year 2020
  - WHO member countries
  - IAPB (NGO’s)
  - Private sector
Global Blindness Prevention

3 Components:
- Effective disease control
- Human resource development
- Infrastructure development
Global Blindness

BLIND (millions)

- 1980: 30
- 1990: 38
- 2000: 50
- 2010: 60
- 2020: 75
Leading Causes of Preventable Blindness

Diseases targeted by Vision 2020

- Cataract
- Trachoma
- Onchocerciasis
- Childhood blindness
  - Corneal scarring from
    - Vitamin A deficiency
    - Measles
    - Ophthalmia neonatorum
    - Harmful traditional eye remedies
- Refractive Error (need for glasses)
Cataract
Figure 5-1  Increasing yellow-to-brown coloration of the human lens from 6 months (A) through 8 years (B), 12 years (C), 25 years (D), 47 years (E), 60 years (F), 70 years (G), 82 years (H), and 91 years (I). Brown nuclear cataract in 70-year-old patient (J), cortical cataract in 68-year-old (K), and mixed nuclear and cortical cataract in 74-year-old (L). (Reproduced with permission from Lerman S. Phototoxicity: clinical considerations. Focal Points: Clinical Modules for Ophthalmologists. San Francisco: American Academy of Ophthalmology; 1987, module 8.)
Global Blindness

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Phakoemulsification
Extracapsular Extraction
Vision 2020 in Latin America

- 2002 - 1st organizing committee met in Paraguay
  - 15 others formed by 2006
  - Panama, El Salvador, Bolivia, and Uruguay 2007

- Committees set priorities and begin organizing resources
  - WHO and IAPB initially very involved

- Advocacy for government spending crucial
  - Emphasis on sustainable programs
Gathering Data

- Assess scope of each country’s needs
  - WHO methods for sampling surveys
  - Methods for measuring vision and recording data “in the field”

- Allows development of effective programs
  - “Districts” of 1-2 mil people
Identifying Barriers

- **Accessibility to care**
  - Rural areas underserved
  - **Paraguay:** 1 ophtho per 40,000
    - 90% in Asuncion (more economic opportunity)

- **Fear of surgery**

- **Cost**
Finding Solutions

Accessibility to care
- Outreach programs
- Training programs
  - Incentives for surgeons to stay local
  - Non-physician “cataract surgeons”
    - East Africa
- Pyramidal system of clinics
  - India

Fear of surgery
- Education and good results

Cost
- Minimize fixed costs
  - <20 USD per case in Nepal
- Tiered pricing system
Pyramid of care

LV Prasad Eye Institute

Center of excellence
Training center
Service center
Vision center

50,000
500,000
5.0 mil
50.0 mil
Trachoma

A chronic keratoconjunctivitis caused by *Chlamydia trachomatis*  
- Gram negative, obligate intracellular  
- Serotype A-C

The most common infectious cause of blindness

Disease transmission occurs primarily between children and those that care for them

Disease of poor personal and community hygiene
Prevalence

- Once endemic in North America and Europe
  - Disappeared due to improvement in living conditions
- Most prevalent in sub-Saharan Africa; also found in aboriginal Australia, Brazil, India, southeast Asia
- 84 million with active disease
  - Significant female preponderance
- 6 million are blind
**TF Follicular Trachoma:** 5 or more follicles (>0.5mm) in the upper tarsal conjunctiva

**TI Inflammatory Trachoma:** Inflammatory thickening of the upper tarsal conjunctiva that obscures more than half the normal vessels

**TS Trachoma Scarring:** presence of easily visible scars

**TT Trichiasis**
- at least 1 lash

**CO Corneal Opacity**
- obscures ½ the pupil
Prevention

1999-Morocco began comprehensive program
  – multiple govt and internatl agencies involved

SAFE strategy
  – **Surgery**
    - >30,000 surgeries in endemic areas
  – **Antibiotics**
    - 4.3 million treatments administered
  – **Facial cleanliness**
  – **Environmental Improvement**
    - Local village associations drilled wells and built latrines
    - Access to potable water now >80% in rural areas
Antibiotic Therapy

WHO recommends 2 antibiotics

- Azithromycin
  - Drug of choice
  - Single dose
  - Directly observe administration
  - High efficacy, low incidence of adverse effects

- Tetracycline ointment
  - Must be used for 6 weeks
Infection Control

- Until 1990s, attempts to control Trachoma in endemic areas were disappointing
- Reinfection is common, treating individual cases is not effective
- Mass administration of sulfa in the 1930s was associated with unacceptably high incidence of severe reactions
  - Including Stevens-Johnson Syndrome
- Mass distribution of tetracycline eye ointment also unsuccessful
  - Use for 6 weeks is required
  - Poor compliance
Who to treat?

- Mismatch between infection and disease
- Rapid reinfection if only individuals with clinical signs are treated
- WHO treatment recommendations:
  - Determine the prevalence of follicular trachoma in 1 to 9 year olds
    - If 10% or higher → mass treatment
    - If less than 10% → targeted treatment
Mass Treatment with Single Dose Azithromycin

- 956 of 978 residents received either single-dose azithromycin or (if contraindicated) a course of tetracycline ointment
  - 916 received azithromycin
- The prevalence fell from 9.5% prior to treatment to
  - 2.1% at 2 months
  - 0.1% at 24 months
Onchocerciasis

- AKA “river blindness”
- 1 million are blind from the disease
- 2nd leading cause of infectious blindness
FIG XXI-3—Life cycle of *Onchocerca volvulus*. A microfilaria, or $L_1$, ingested from the skin of an infected subject by a blackfly during a blood meal molts twice, through $L_2$ to $L_3$, in the blackfly over a period of 6–12 days. The $L_3$, or infective larva, is inoculated during a subsequent blood meal into another human being. In the human being, the $L_3$ molts twice through $L_4$ and $L_5$ to become an adult male or female worm. (Courtesy of Yankum Dadzie, MD.)
Pathophysiology

- Insect borne disease, caused by the nematode worm *Onchocerca volvulus*
- Transmitted by a black fly: *Simulium*
  - Their eggs require fast-running rivers for breeding grounds
- The flies require a blood meal to initiate ovulation, and this transmits the infection to humans
- The adult worms give birth daily to thousands of microscopic larvae known as microfilariae
Prevalence

- Endemic in 30 countries in sub-Saharan Africa
- Also found in Sudan, Yemen, Latin America, and SE Asia
Morbidity

- Most microfilariae die as immature worms in the host
- Their death causes an intense inflammatory reaction that is responsible for most of the morbidity
- Leads to blindness, dermatitis, and lymphadenitis
- The ocular tissues are involved via migration through blood vessels and nerves
Skin Manifestations

- The classic lesion is the onchocercoma
  - Painless nodule in the subQ tissue
  - Predominantly on the head, face, and torso
  - Composed of 2-3 females and microfilariae encapsulated in a fibrous coat

- “Leopard skin”
  - Islands of hyperpigmented skin surrounded by depigmentation
    - Affect mobility and social acceptability
Skin Lesions

“Leopard Skin”

“Hanging Groin Sign”
Eye Disease

- Onchocerciasis-related blindness results from the inflammatory response
- Can affect all parts of the eye
  - Lid nodules, conjunctivitis, phlyctenule-like masses, scleritis, irits, chorioretinitis, neuroretinitis can all occur
  - Strains found in Africa may lead to a sclerosing keratitis not seen in Latin America
Treatment

- Ivermectin is the only drug recommended
- Developed in 1980s, donated for free in 1987 by Merck
- A single dose of ivermectin is highly effective for 1 year (150mcg/Kg)
- Kills the microfilariae, not the adult worms, so must be given yearly for 12-15 years (the lifespan of the worms)
  - Also embryostatic and shortens macro’s lifespan
- Very safe
  - RAPLOA- screening questionnaire for Loa loa (eye worm)
Control and Treatment

- **Onchocerciasis Control Programme (OCP)**
  - Joint effort of the WHO, UN agencies, and non-governmental organizations
- Launched in 1974, originally involving 7 countries in West Africa
  - Expanded to 1.23 million sq km
- Vector control with aerial spraying combined with mass distribution of ivermectin
  - Used environmentally safe larvicides (B. thuringiensis)
- Virtually eliminated onchocerciasis as a public health problem in this region
- Cost <1 dollar per person per year
FIG XXI-4—Distribution of epidemiologic parameters on onchocerciasis—that is, mf-positive individuals, visual acuity of 3/60-6/60 or 20/400-20/200, and visual acuity less than 3/60 or 20/400—in the populations examined in representative villages in 11 countries in the OCP before vector-control activities were begun. The abscissa shows names of the countries in which the examinations were carried out, the number of persons examined, and, in parentheses, the number of villages. (Courtesy of Yankum Dadzie, MD.)

FIG XXI-5—Distribution of epidemiologic parameters on onchocerciasis—that is, mf-positive individuals, visual acuity of 3/60-6/60 or 20/400-20/200, and visual acuity less than 3/60 or 20/400—in the populations examined in representative villages in 11 countries in the OCP 8-11 years after vector-control activities were begun. The abscissa shows names of the countries in which the examinations were carried out, the number of persons examined, and, in parentheses, the number of villages. (Courtesy of Yankum Dadzie, MD.)
Future Issues

- Development of an effective, safe filaricide
  - Existent meds for the adult worms can have serious side effects

- How long must ivermectin treatment programs continue?
  - Is resistance developing?
Childhood Blindness

- Many of the causes are preventable or treatable
  - Vitamin A deficiency, measles, rubella cataract
- The conditions associated with blindness are also causes of child mortality
  - 3 million children die of Vitamin A deficiency-related illnesses annually
- Urgency to treat to prevent amblyopia
Vitamin A Deficiency

- Leading cause of childhood blindness in developing countries
  - 500,000 children are blind from Vitamin A deficiency
- Associated with severe protein malnutrition and infectious diseases
  - Squamous metaplasia and keratinization of conj
  - Loss of goblet cells
- 4 stages
  - Night blindness
    - Inability to regenerate rhodopsin
  - Conjunctival signs
  - Corneal signs
  - Sequelae of active corneal lesions and scars
Conjunctival Lesions

- Xerosis is an isolated, dry, wrinkled lesion that repels tears
- Bitot spot: A xerotic plaque overlaid by a white foamy material
  - Loss of goblet cells leads to accumulation of bacteria and keratin
  - Resolves within 3 months after treatment
Corneal Signs

- SPK progressing to an orange peel appearance as a result of confluent SPK and anterior stromal edema
- Corneal ulceration and keratomalacia (stromal melt)
Measles Comorbidity

- Vitamin A deficiency is an important risk factor for ocular complications of measles.
- During acute measles infection, vitamin A levels drop precipitously as a result of catabolism. - Precipitates severe corneal xerophthalmia.
- Treatment with vitamin A is associated with a 50% reduction in measles-related mortality.
Prevention

- Periodic supplementation with high-dose vitamin A
- Immunizations
- Increasing dietary intake of vitamin A rich foods
  - Sweet potatoes
Global Blindness

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Reasons for Success

- The donation by Merck of ivermectin to “as many as need it, for as long as needed”
- The development of a cost effective, rapid assessment method to identify endemic communities
  - REMO (Rapid Epidemiological Mapping of Onchocerciasis)
  - Within 5 years enabled mapping of all endemic communities
- Significant improvement in many of the tools used in control activities
- Community-directed treatment
References

- BCSC, International Ophthalmology
Mass Treatment with Single Dose Azithromycin


Quantitative PCR was used to determine the effectiveness of single-dose, mass distribution of azithromycin in Tanzania, where trachoma is endemic

Followed for 2 years after single treatment
How often to treat?

- Mathematical model used to predict the frequency of treatment needed
  - Q6mo if >50% of children have trachoma
  - Annual if <35% of the children have trachoma

- This model was based on analysis of disease
  - Poor correlation between disease and infection
  - Biannual treatment supported by Ethiopian study
Population, Enrollment, Treatment

In July 2000, each consenting resident was screened using WHO grading system.
The tarsal conjunctiva of each subject’s right eye was swabbed for PCR.
Every non-pregnant resident 12 months of age or older was offered one directly-observed dose of azithromycin 20mg/kg.
- 1 gram in adults
Pregnant women and children <12 months of age were given 2 tubes of tetracycline ointment and instructions to use it twice daily for 6 weeks.
Follow-up

- Offered monthly enrollment to new residents and new infants
  - Swabs for PCR were obtained
- Examination and swabbing was performed by the same examiner at 2, 6, 12, 18, and 24 months
- At follow-up exam, patients with active infection were given tetracycline for ethical reasons
Conclusions

- The prevalence of infection fell dramatically and remained low for 2 years after treatment.
- One round of mass treatment with azithromycin can interrupt the transmission of ocular C. trachomatis infection.

Criticism:
- 98% compliance rate is much higher than with most public health efforts.
- Screening all new residents/infants.
Disease Process

- Most patients are relatively asymptomatic
- Two phases
  - Active inflammation
  - Scarring (cicatricial)
- Both phases may coexist
Active Infection

- Follicular conjunctivitis of the upper lid
- Intense inflammation
  - Plasma cells and macrophages infiltrate the follicles
- Cornea
  - Limbal follicles
  - Superior neovascularization
  - Punctate keratitis
Cicatricial Stage

- Chronic inflammation leads to tarsal conjunctival scarring
- Upper tarsal plate becomes distorted
- Entropion and trichiasis
- Corneal opacification and scarring
WHO: Trachoma Grading Card

- A simplified grading system that is easy to use in the field and is reproducible
- Divides trachoma into 5 stages
Cape Coast, Ghana
O.R. and scrub area
Hotel room and portable mosquito net