Bio 117  Neglected Tropical Diseases  
Instructor:  Sullivan  
Winter 2017  

Tuesdays  9:50- 11:25  
Porter Acad 148  

Thursdays 9:50- 11:25  
Biomed 300 (groups of 12)  

Office hours: Thursdays 12-2 (Sinsheimer 322)
Class website:
https://sites.google.com/site/bio117globalhealth/home
OR
Google “sullivan lab santa cruz” click TEACHING
Course objectives:

To learn about the diseases afflicting the “bottom billion”

This includes understanding the

1. The molecular and cellular basis of these diseases
2. The vectors (usually insects) involved in disease transmission
3. The clinical manifestation of these diseases
4. How these diseases are currently managed
5. The effect of disease burden on a society
6. Current and emerging approaches to combat these diseases
7. Career Opportunities in Neglected Diseases and Global Health
Course Organization:

Tuesdays: Lectures based on reading handed out the previous week

Thursdays: I will schedule groups of 10-15 to give 8 minute oral presentations (see handout for the format of these presentations). The first of these Presentations will be held Thursday Jan 19th
First meeting this Thursday Jan 19th

Course Evaluation:

Two oral presentations (first is practice, second is graded) 33%

In class midterm: short answer 33%

Final take home essay exam 33%

The beginning of each lecture will be devoted student (volunteer) 5 minute Ebola/Zika update presentations (SEE ME AFTER CLASS IF INTERESTED)
How are Neglected Tropical diseases defined? Where did the name come from?

Millennium Summit of the United Nations in 2000, one of the eight goals to improve health and wellness worldwide was to combat HIV, malaria, tuberculosis (this had star power-Bono of U2 fame)

The downside was that many other diseases of impoverished nations likely to be ignored

The originator of the term, Dr. Hotez, said it was a branding idea to promote awareness of infectious diseases that thrive in areas of poverty and conflict

Named 12 diseases has since been expanded to 17.
Why Neglected Tropical Diseases?

There are 100's of Tropical diseases which should be included?

1. These are diseases associated with poverty which is concentrated in the tropics (those living less than $1-2/day)

2. Usually do not kill but have huge impact on an individual’s quality of life

3. Large economic impact

4. Limited ability of local health care system to respond
More than 1 billion people—one-sixth of the world's population—suffer from one or more Neglected Tropical Diseases (NTDs).

NTDs are a group of infectious diseases that are the source of tremendous suffering because of their disfiguring, debilitating, and sometimes deadly impact.

They have been largely wiped out in the more developed parts of the world and persist only in the poorest, most marginalized communities and conflict areas.

Social stigma is a major consequence of NTDs. In addition to causing physical and emotional suffering, these devastating diseases hamper a person's ability to work.
100% of low-income countries are affected by at least five neglected tropical diseases simultaneously.

Worldwide, 149 countries and territories are affected by at least one neglected tropical disease (NTD).

Neglected tropical diseases kill an estimated 534,000 people worldwide every year (usually after prolonged illness).

Individuals are often affected with more than one parasite or infection.

Treatment cost for most NTD mass drug administration programs is estimated at less than US fifty cents per person, per year.
The 17 Neglected Tropical Diseases prioritized by WHO affect over 1 billion and are endemic in 149 countries.
The 17 Neglected Tropical Diseases prioritized by WHO affect over 1 billion and are endemic in 149 countries.

**Chagas disease (Protozoa)**

**Dengue (Break-bone fever) Virus**

**Elephantiasis (nematode)**

**Leprosy (Bacteria)**
Want to make an impact?

### WHAT DOES IT MEAN TO BE “NEGLIGENCE”?

Neglected Tropical Diseases impact daily life for millions of people globally. However, funding for research and treatment of them pales in comparison to “first-world impacted or supported” diseases such as HIV/AIDS.

Social and moral questions arise when trying to understand why some diseases are favored over others, adding a new perspective on what it means to be truly neglected.

Thomson Reuters Global Research Report: Neglected Tropical Diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Affected Population</th>
<th>Research Papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>346 Million</td>
<td>194,481</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>34 Million</td>
<td>154,562</td>
</tr>
<tr>
<td>Elephantiasis</td>
<td>120 Million</td>
<td>1,858</td>
</tr>
<tr>
<td>Intestinal Worms</td>
<td>~1 Billion</td>
<td>10,770</td>
</tr>
</tbody>
</table>

Sources: Thomson Reuters Web of Knowledge, World Health Organization
There is little incentive for companies to develop drugs to combat neglected diseases.

**Fig. 1. Global pharmaceutical market and disease R&D targets:** For the most neglected diseases, patients are so poor that they have virtually no purchasing power and can provide no market stimulus to spark interest in drug R&D among pharmaceutical companies.
Neglected diseases are becoming prevalent in the southern United States

Major Neglected Tropical Diseases in Texas
Parasitic Infections
Chagas disease
Cutaneous leishmaniasis
Cysticercosis
Toxocariasis
Trichomoniasis
Bacterial and Viral Infections
Murine typhus
Tuberculosis in diabetes mellitus
Dengue
West Nile virus
Chagas disease causes the highest burden of any parasitic disease in the Western hemisphere. It is estimated that 300,167 individuals with Trypanosoma cruzi infection live in the United States.

Distribution of Triatomine bugs (kissing bugs), the vector for Chagas disease
Based on data from (CDC), dengue is present in the US and its territories throughout 2013, with 20 cases in Florida, 3 in Texas, 7,221 in Puerto Rico.

Aedes aegypti Mosquito is the vector for the Dengue virus
Take home message:
Neglected Diseases also afflict the poorest individuals in wealthy nations.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diseases of the heart</td>
<td>28.5</td>
</tr>
<tr>
<td>2. Malignant tumors</td>
<td>22.8</td>
</tr>
<tr>
<td>3. Cerebrovascular diseases (Stroke)</td>
<td>6.7</td>
</tr>
<tr>
<td>4. Chronic lower respiratory diseases</td>
<td>5.1</td>
</tr>
<tr>
<td>5. Accidents (unintentional injuries)</td>
<td>4.4</td>
</tr>
<tr>
<td>6. Diabetes mellitus</td>
<td>3.0</td>
</tr>
<tr>
<td>7. Influenza and pneumonia</td>
<td>2.7</td>
</tr>
<tr>
<td>8. Alzheimer's disease</td>
<td>2.4</td>
</tr>
<tr>
<td>9. Nephritis, nephrotic syndrome, and nephrosis</td>
<td>1.7</td>
</tr>
<tr>
<td>10. Septicemia (blood poisoning)</td>
<td>1.4</td>
</tr>
<tr>
<td>11. Suicide</td>
<td>1.3</td>
</tr>
<tr>
<td>12. Chronic liver disease and cirrhosis</td>
<td>1.1</td>
</tr>
<tr>
<td>13. Primary hypertension and renal disease</td>
<td>0.8</td>
</tr>
<tr>
<td>14. Parkinson's disease (tied)</td>
<td>0.7</td>
</tr>
<tr>
<td>15. Homicide (tied)</td>
<td></td>
</tr>
</tbody>
</table>

Consequently much of health care, delivery, infrastructure and research in the US devoted toward treating these diseases.
As the economies of poor nations improve, there is a corresponding increase in diseases typical of wealthy nations.
**Neglected tropical diseases by the numbers**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Infected globally</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hookworm infection</td>
<td>576 million</td>
</tr>
<tr>
<td>2 Ascaris</td>
<td>807 million</td>
</tr>
<tr>
<td>3 Trichuris</td>
<td>604 million</td>
</tr>
<tr>
<td>4 Lymphatic filariasis</td>
<td>120 million</td>
</tr>
<tr>
<td>5 Schistosomiasis</td>
<td>207 million</td>
</tr>
<tr>
<td>6 Trachoma</td>
<td>84 million</td>
</tr>
<tr>
<td>7 Onchocerciasis</td>
<td>37 million</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>&gt;1 billion</strong></td>
</tr>
</tbody>
</table>

(Global Population = 7 billion)
<table>
<thead>
<tr>
<th>Parasite</th>
<th>Tissue/Organ</th>
<th>Disease manifestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hookworm (nematode)</td>
<td>Small Intestine</td>
<td>Anemia, Emaciation, Cardiac failure</td>
</tr>
<tr>
<td>Ascaris (nematode)</td>
<td>Small intestine</td>
<td>Abdominal issues, retards growth in children</td>
</tr>
<tr>
<td>Trichuris (whip-worm)</td>
<td>Large intestine</td>
<td>Diarrhea, anemia, retards growth in children</td>
</tr>
<tr>
<td>Lymphatic filariasis (nematode)</td>
<td>Lymph node</td>
<td>Excessive swelling (elephantiasis)</td>
</tr>
<tr>
<td>Schistosomiasis (nematode)</td>
<td>Blood vessels live</td>
<td>Skin rash itching, organ damage</td>
</tr>
<tr>
<td>Trachoma (bacteria)</td>
<td>Eye</td>
<td>Breakdown of cornea blindness</td>
</tr>
<tr>
<td>Onchocerciasis (nematode)</td>
<td>Eye</td>
<td>Blindness</td>
</tr>
</tbody>
</table>
The 17 Neglected Tropical Diseases prioritized by the World Health Organization

**Protozoa**
- Chagas disease
- Trypanosomiasis
- Leishmaniasis

**Virus**
- Rabies
- Dengue

**Helminth**
- Cysticercosis/Taeniasis
- Drancunculiasis (guinea worm disease)
- Echinoioccosis
- Trematodiasis
- Lymphatic filariasis
- Onchoceriasis (River-blindness)
- Schistosomiasis
- Soil-transmitted helminthiasis

**Bacteria**
- Buruli ulcer
- Leprosy
- Trachoma
- Yaws
The major neglected diseases listed do not show up on the list below. Why not?
The 17 Neglected Tropical Diseases prioritized by the World Health Organization

Protozoa
- Chagas disease
- Trypanosomiasis
- Leishmaniasis

Virus
- Rabies
- Dengue

Helminth
- Cysticercosis/Taeniasis
- Dracunculiasis (guinea worm disease)
- Echinooccosis
- Trematodiasis
- Lymphatic filariasis
- Onchoceriasis (River-blindness)
- Schistosomiasis
- Soil-transmitted helminthiasis

Bacteria
- Buruli ulcer
- Leprosy
- Trachoma
- Yaws

These diseases do not kill (at least in the near term)
The 10/90 gap refers to the statistical finding of the Global Forum for Health Research that only 10% of worldwide expenditure on health research and development is devoted to the problems that primarily affect the poorest 90% of the world population.

The 10/90 gap
Most drug research is for the wealthiest people on earth

More than
$70bn
is spent each year in the world on research and development of new drugs

Less than
10%
of this is spent on
90%
of the world's health problems

New drugs are needed for: sleeping sickness, dengue fever, malaria, schistosomiasis, tuberculosis, chagas disease, lymphatic filariasis, leishmaniasis, leprosy, onchoceriasis.
Global map and overlap of six of the common NTDs. Specifically guinea worm disease, lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminths, trachoma.
Neglected diseases are concentrated in the tropics, but this is primarily due to the fact that poverty is greatest in the rural areas, urban slums and displaced population near the equator.

Rather than referring to them as tropical diseases, some have suggested labeling them the diseases of the bottom billion.

Why are they concentrated in these regions?

Sanitation

Drinking water

Housing

Medical care

Education
How much of a health problem are neglected diseases? Is there a way to quantify the burden of an individual disease?

In early 1990s, a study by the World Bank, WHO, and the Harvard School of Public Health launched an initiative to devise a metric to quantify disease burden.

Three objectives:

1. Facilitate inclusion of non-fatal diseases on global health policies (previous focus on mortality of rates of children under 5).

2. Decouple health policy decisions from influence of advocacy groups.

3. To quantify disease burden that could also be used for to measure the cost effectiveness of interventions.
DALY --- disability adjusted life year is a metric used to estimate the total disease burden on a population

DALYs estimate the number of “healthy” life years lost due to disease or disability by incorporating non-fatal as well as fatal conditions

YLD- years of life lived with a disability
YLL- years life lost due to premature death

\[ \text{DALY} = \text{YLD} + \text{YLL} \]

Premise that the best approach for measuring disease burden is to use units of time as a measure
(or more precisely time of healthy years of life lost)

http://www.who.int/healthinfo/nationalburdenofdiseasemanual.pdf
DALY measures the gap between a population’s actual health status and some “ideal” or reference status.

This requires making social value choices:

How long should people in good health expect to live?

How should we compare years life lost through death with years lived with poor health or disability of various severity levels?

Are lost years of healthy life valued more at some ages than others? The GBD chose to value a year of life at young adult ages more than in old age or infancy

Are all people equal? Do all people lose the same amount of health through death at a given age if there are variations in current life expectancies between population groups?

The Global Burden of Disease Study used the same values for all regions of the world. The same expectancy ‘ideal’ standard for all populations regardless of current life expectancies and equal value to a year of healthy life lost. (Japan is the ideal: 80 years for males and 82 for females)
A male individual becomes blind at 40 due to a disease

**DALY-** Disability Adjusted Life Years =

**YLD-** Years of life lived with a disability

**YLL-** Years life lost due to premature death

\[
\text{DALY} = \text{YLD} + \text{YLL} \\
= 0.5(80-40) + 0 \\
= 20 \text{ DALYs}
\]
Table 1. Differences across countries per disease stage in terms of VAS scores (0 = no disability, 1= maximum disability) for 15 disease stages obtained in panel sessions in England and Wales, France, the Netherlands, Spain, and Sweden

<table>
<thead>
<tr>
<th>Disease stage</th>
<th>Pooled (n = 231)</th>
<th>England and Wales (n = 49)</th>
<th>France (n = 46)</th>
<th>Netherlands (n = 50)</th>
<th>Spain (n = 47)</th>
<th>Sweden (n = 39)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common cold</td>
<td>0.03 ± 0.04</td>
<td>0.04 ± 0.06</td>
<td>0.03 ± 0.02</td>
<td>0.03 ± 0.05</td>
<td>0.04 ± 0.04</td>
<td>0.03 ± 0.03</td>
</tr>
<tr>
<td>Vision disorder (mild/moderate)</td>
<td><strong>0.17 ± 0.17</strong></td>
<td><strong>0.17 ± 0.14</strong></td>
<td>0.29 ± 0.29</td>
<td>0.13 ± 0.06</td>
<td>0.15 ± 0.11</td>
<td>0.14 ± 0.08</td>
</tr>
<tr>
<td>Breast cancer (disease-free, no permanent sequelae)</td>
<td>0.32 ± 0.18</td>
<td>0.37 ± 0.22</td>
<td>0.29 ± 0.19</td>
<td>0.27 ± 0.11</td>
<td>0.39 ± 0.15</td>
<td>0.26 ± 0.14</td>
</tr>
<tr>
<td>Low back pain</td>
<td>0.33 ± 0.18</td>
<td>0.37 ± 0.20</td>
<td>0.34 ± 0.17</td>
<td>0.28 ± 0.15</td>
<td>0.32 ± 0.16</td>
<td>0.36 ± 0.20</td>
</tr>
<tr>
<td>Diabetes (difficult to control)</td>
<td>0.34 ± 0.16</td>
<td>0.40 ± 0.17</td>
<td>0.39 ± 0.14</td>
<td>0.31 ± 0.10</td>
<td>0.31 ± 0.14</td>
<td>0.37 ± 0.16</td>
</tr>
<tr>
<td>Asthma (severe)</td>
<td>0.46 ± 0.19</td>
<td>0.53 ± 0.20</td>
<td>0.43 ± 0.23</td>
<td>0.43 ± 0.14</td>
<td>0.43 ± 0.17</td>
<td>0.48 ± 0.15</td>
</tr>
<tr>
<td>Dementia (mild)</td>
<td><strong>0.46 ± 0.21</strong></td>
<td>0.50 ± 0.23</td>
<td>0.46 ± 0.23</td>
<td>0.46 ± 0.17</td>
<td>0.47 ± 0.19</td>
<td>0.41 ± 0.21</td>
</tr>
<tr>
<td>Colorectal cancer (diagnosis + primary therapy)</td>
<td>0.51 ± 0.20</td>
<td>0.53 ± 0.22</td>
<td>0.48 ± 0.21</td>
<td>0.47 ± 0.14</td>
<td>0.64 ± 0.15</td>
<td>0.41 ± 0.18</td>
</tr>
<tr>
<td>HIV (seropositive, minor)</td>
<td>0.55 ± 0.22</td>
<td>0.56 ± 0.21</td>
<td>0.60 ± 0.22</td>
<td>0.43 ± 0.19</td>
<td>0.65 ± 0.21</td>
<td>0.52 ± 0.20</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>0.59 ± 0.20</td>
<td>0.64 ± 0.22</td>
<td>0.61 ± 0.22</td>
<td>0.49 ± 0.13</td>
<td>0.67 ± 0.16</td>
<td>0.52 ± 0.18</td>
</tr>
<tr>
<td>Angina pectoris (severe stable)</td>
<td>0.59 ± 0.16</td>
<td>0.65 ± 0.15</td>
<td>0.58 ± 0.18</td>
<td>0.54 ± 0.13</td>
<td>0.59 ± 0.14</td>
<td>0.56 ± 0.15</td>
</tr>
<tr>
<td>Stroke (moderate permanent impairments)</td>
<td>0.68 ± 0.16</td>
<td>0.69 ± 0.17</td>
<td>0.68 ± 0.17</td>
<td>0.64 ± 0.13</td>
<td>0.75 ± 0.13</td>
<td>0.64 ± 0.15</td>
</tr>
<tr>
<td>Depression (severe)</td>
<td><strong>0.78 ± 0.17</strong></td>
<td>0.74 ± 0.22</td>
<td>0.77 ± 0.21</td>
<td>0.82 ± 0.12</td>
<td>0.76 ± 0.13</td>
<td>0.83 ± 0.14</td>
</tr>
<tr>
<td>Quadriplegia</td>
<td>0.91 ± 0.10</td>
<td>0.89 ± 0.12</td>
<td>0.93 ± 0.07</td>
<td>0.89 ± 0.05</td>
<td>0.94 ± 0.06</td>
<td>0.88 ± 0.13</td>
</tr>
<tr>
<td>Final year of disease</td>
<td>0.91 ± 0.10</td>
<td>0.92 ± 0.09</td>
<td>0.96 ± 0.05</td>
<td>0.87 ± 0.07</td>
<td>0.95 ± 0.06</td>
<td>0.87 ± 0.12</td>
</tr>
</tbody>
</table>
DALYs are weighed to place a greater value on a year lived as a young adult.

First 22 years, society invests tremendous resources in raising, educating an individual.

In return, there is a pay-off to society by that individual over the next 30 yrs.

Disability Adjusted Life Year Weights

weight = 0.1658 year e^{-0.04 year}
HIV DALY = YLD + YLL

YLD - years of life lived with a disability
YLL - years of life lost due to premature death
Neglected tropical diseases:
Infection rates and global disease burden

<table>
<thead>
<tr>
<th>Disease</th>
<th>DALYs</th>
<th>Infected globally</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hookworm infection</td>
<td>22.1 million</td>
<td>576 million</td>
</tr>
<tr>
<td>2 Ascaris</td>
<td>10.5 million</td>
<td>807 million</td>
</tr>
<tr>
<td>3 Trichuris</td>
<td>6.4 million</td>
<td>604 million</td>
</tr>
<tr>
<td>4 Lymphatic filariasis</td>
<td>5.8 million</td>
<td>120 million</td>
</tr>
<tr>
<td>5 Schistosomiasis</td>
<td>4.5 million</td>
<td>207 million</td>
</tr>
<tr>
<td>6 Trachoma</td>
<td>2.3 million</td>
<td>84 million</td>
</tr>
<tr>
<td>7 Onchocerciasis</td>
<td>0.5 million</td>
<td>37 million</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52.1 million</strong></td>
<td><strong>&gt;1 billion</strong></td>
</tr>
</tbody>
</table>
Top 10 Infectious diseases calculated by Disability Adjusted Life Years

$$\text{DALY} = \text{YLD} + \text{YLL}$$

- **YLD** - years of life lived with a disability
- **YLL** - years life lost due to premature death

<table>
<thead>
<tr>
<th>Infectious Disease</th>
<th>DALYs (x 1000)</th>
<th>Vector</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>64 662</td>
<td></td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>55 971</td>
<td></td>
</tr>
<tr>
<td>Malaria</td>
<td>32 342</td>
<td>Mosquitoes</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>28 698</td>
<td></td>
</tr>
<tr>
<td>Childhood diseases</td>
<td>23 194</td>
<td></td>
</tr>
<tr>
<td>Tropical diseases</td>
<td>9 920</td>
<td></td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>1 409</td>
<td>Tsetse flies</td>
</tr>
<tr>
<td>Chagas disease</td>
<td>342</td>
<td>Triatomine bugs</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>1 457</td>
<td>Snails</td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>1 486</td>
<td>Sand flies</td>
</tr>
<tr>
<td>Lymphatic filariasis</td>
<td>4 879</td>
<td>Mosquitoes</td>
</tr>
<tr>
<td>Onchocerciasis</td>
<td>348</td>
<td>Black flies</td>
</tr>
<tr>
<td>STDs excluding HIV</td>
<td>9 280</td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td>8 823</td>
<td></td>
</tr>
<tr>
<td>Intestinal nematode infections</td>
<td>3 274</td>
<td></td>
</tr>
<tr>
<td>Hepatitis B (d)</td>
<td>1 669</td>
<td></td>
</tr>
</tbody>
</table>

*Table: Of the 10 major infectious disease groupings resulting in the largest number of Disability Adjusted Life Years (DALYs) lost, two are composed of vector-borne diseases (highlighted in yellow) (Source: WHO, 2008).*
Notice many infectious diseases are transmitted to humans through an insect vector.

<table>
<thead>
<tr>
<th>Infectious Disease</th>
<th>DALYs (x 1000)</th>
<th>Vector</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>64 662</td>
<td></td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>55 971</td>
<td></td>
</tr>
<tr>
<td>Malaria</td>
<td>32 342</td>
<td>Mosquitoes</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>28 698</td>
<td></td>
</tr>
<tr>
<td>Childhood diseases</td>
<td>23 194</td>
<td></td>
</tr>
<tr>
<td>Tropical diseases</td>
<td>9 920</td>
<td></td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>1 409</td>
<td>Tsetse flies</td>
</tr>
<tr>
<td>Chagas disease</td>
<td>342</td>
<td>Triatomine bugs</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>1 457</td>
<td>Snails</td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>1 486</td>
<td>Sand flies</td>
</tr>
<tr>
<td>Lymphatic filariasis</td>
<td>4 879</td>
<td>Mosquitoes</td>
</tr>
<tr>
<td>Onchocerciasis</td>
<td>348</td>
<td>Black flies</td>
</tr>
<tr>
<td>STDs excluding HIV</td>
<td>9 280</td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td>8 823</td>
<td></td>
</tr>
<tr>
<td>Intestinal nematode infections</td>
<td>3 274</td>
<td></td>
</tr>
<tr>
<td>Hepatitis B (d)</td>
<td>1 669</td>
<td></td>
</tr>
</tbody>
</table>

Table: Of the 10 major infectious disease groupings resulting in the largest number of Disability Adjusted Life Years (DALYs) lost, two are composed of vector-borne diseases (highlighted in yellow). (Source: WHO, 2008)

**Vectors** are organisms that transmit pathogens and parasites from one infected person (or animal) to another.
Infection cycle of a filarial nematode based disease known as Elephantiasis (Lymphatic Filariasis)

Tissue swelling – legs, feet, and scrotum

Afflicted individuals shunned by community
The Mosquito is the vector for filarial nematodes that cause Elephantiasis (Lymphatic Filariasis)

Individual Infected with Filarial Nematode

Soon to be infected!

Vector Control is becoming a hot area of research
Good news stories in Global Health and Neglected Tropical Diseases

Global Health breakthroughs over the past 25 years:

An increase in the average life expectancy at birth worldwide to 70 Years: a child born today can expect to live 6 years longer than a child born in 1990

Halving of child mortality: deaths of children under 5 12.2 to 6.3 million from 1990 to 2013

HIV transformed from death sentence to manageable chronic disease 9 million receive anti-retroviral treatment

Effective preventive interventions: new vaccines, insecticidal bed nets, nutrient supplementation

New effective drugs against hepatitis C virus infection
A Neglected Disease Success story

Dracunculiasis (guinea-worm disease)-

Dracunculiasis is a crippling parasitic disease caused by a long thread-like worm.

The disease is transmitted exclusively when people who have little or no access to improved drinking water sources swallow water contaminated with parasite-infected water-fleas (cyclops).
Life cycle of the guinea worm

1. Person drinks well or pond water containing water fleas (Cyclops) that are infected with mature (third-stage) worm larvae.

2. Gastric juices in the human stomach digest the water fleas. Worm larvae are released and move to the abdominal tissues, where they grow and mate.

3. Fertilized female worms migrate to various body regions, usually the lower limbs. (Males die soon after mating.)

4. A year after infection the worm begins to emerge through the skin at the site of a painful blister.

5. On contact with water the emerging worm releases immature (first-stage) larvae into the water source, often a pond or shallow well. A free-living larva survives only three days unless it finds a host.

6. Water flea consumes worm larvae, which resist digestion.

7. In two weeks the larvae undergo two molts within the water flea to become third-stage larvae, which can infect humans.

© 2011 Encyclopædia Britannica, Inc.
Water flea (Cyclops) carry the guinea worm (Dracunulus medinensis)
By inducing a painful blister the guinea worm promotes its transmission to its water flea host.

About one year after the infection, a painful blister forms - 90% of the time on the lower leg – and one or more worms emerge accompanied by a burning sensation. To soothe the burning pain, patients often immerse the infected area in water.
Guinea worm disease is set to become the second human disease in history, after smallpox, to be eradicated.

It will be the first parasitic disease to be eradicated and the first disease to be eradicated without the use of a vaccine or medicine.
How was this achieved?

There is no known curative medicine or vaccine to prevent Guinea worm disease — the same treatment for emerging worms has been used for thousands of years.
Traditional removal of a Guinea worm consists of winding the worm around a piece of gauze or small stick and manually extracting it — a slow, painful process that often takes weeks. The skin lesions often develop secondary bacterial infections, which exacerbate the suffering and prolong the period of disability.

Guinea worm is more than 3,000 years old. It has been found in Egyptian mummies. Many believe the symbol of medicine often interpreted as a snake wrapped around a stick may be a Guinea worm.
Defeating the parasite is primarily "a matter of education," says Dr. Ruiz-Tiben. When villagers learn to filter their water through simple nylon water filters before consumption, and not to enter the water when they are infected, the parasites disappear--they cannot survive without their human hosts. "That's why it can be eradicated worldwide," he says.

Strategy was to break cycle of infection using nylon water filters
Guinea Worm Disease has decreased from 3.5 million cases in 1986 to 542 cases in 2012 and 148 cases in 2013. Achieved through nylon mesh, education and many dedicated health workers.
END7: How to Shock a Celebrity - YouTube
https://www.youtube.com/watch?v=sYimJKg9QiE

https://www.youtube.com/watch?v=sYimJKg9QiE
The following students will be giving 8 minute talks next Thursday

DON'T LEAVE!

Arleah Aguilar
Dominique Brashear
Megan Carey
Colin Dailey
Gino Gamboa
Samuel Horton
Karen Judge
Yosof Katiby
Anakarina Lance
Ada Madejska
Hector Navarro
Valerie Okakpu
Joanna Perez
Arian Rahbar