# Burden of Disease

# Dr Wendy Harrison
## BSc BVetMed MPH PhD MRCVS

*Managing Director, Schistosomiasis Control Initiative, London Centre for Neglected Tropical Diseases, School of Public Health*

**Imperial College London**

100 years of living science

# Learning Objectives

## Understand the

- need for objective measure of burden of disease
- most widely used methodology for burden of disease assessment DALY
- Usefulness of the DALY
- introduction to cost effectiveness
- burden of disease in a wider context

# Tough Choices

2 NGO interested in contributing to interventions against



**diarrhoea** including vaccination



**depression** and neuropsychiatric disorders

You are the junior health minister and must make recommendations to health and finance ministers

**What information would your need to make your recommendation?**

# Short Answers

- Burden of disease ?

- Cost of prevention  or treatment  ?

- Resource allocation required from health budget ?

# Varying resources available for health

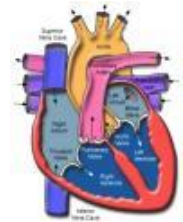| | GDP per capita | % Health care | per person |
|---|---|---|---|
| **Iraq** | 3,553 | | |
| **Liberia** | 397 | | |

*Source :  OECD Health Data, World Bank*

**One IVF course = £2,700**

One-third of a cochlear implant

1 heart bypass operation

11 cataract removals

150 MMR vaccinations

One-thousandth of a Challenger 2 military tank

Borrowed from Nancy Devlin, City University

# Wider Implications on Health Care Spending

- Decision-makers require scientific evidence to justify difficult choices and ensure improve global public health

- Development assistance for health $26.9 billion in 2010. Annual growth has slowed dramatically from 17% to 7% Murray et al The Lancet. 2011

- Many ways of improving people's health in addition to health care interventions

- The maximum improvement in health is achieved by spending in all these different areas.
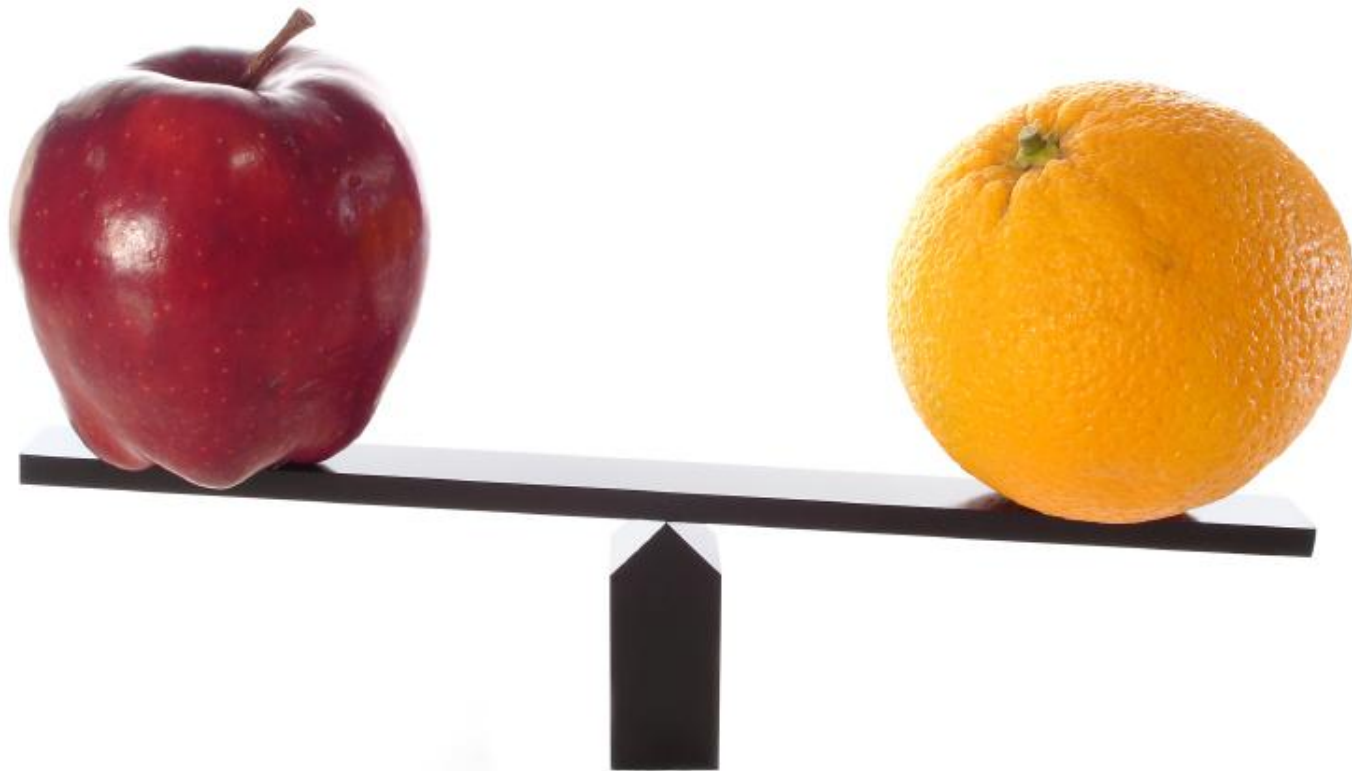
# Allocative efficiency

- Finite resources

- Need to allocate resources in a way they will most efficiently produce an output

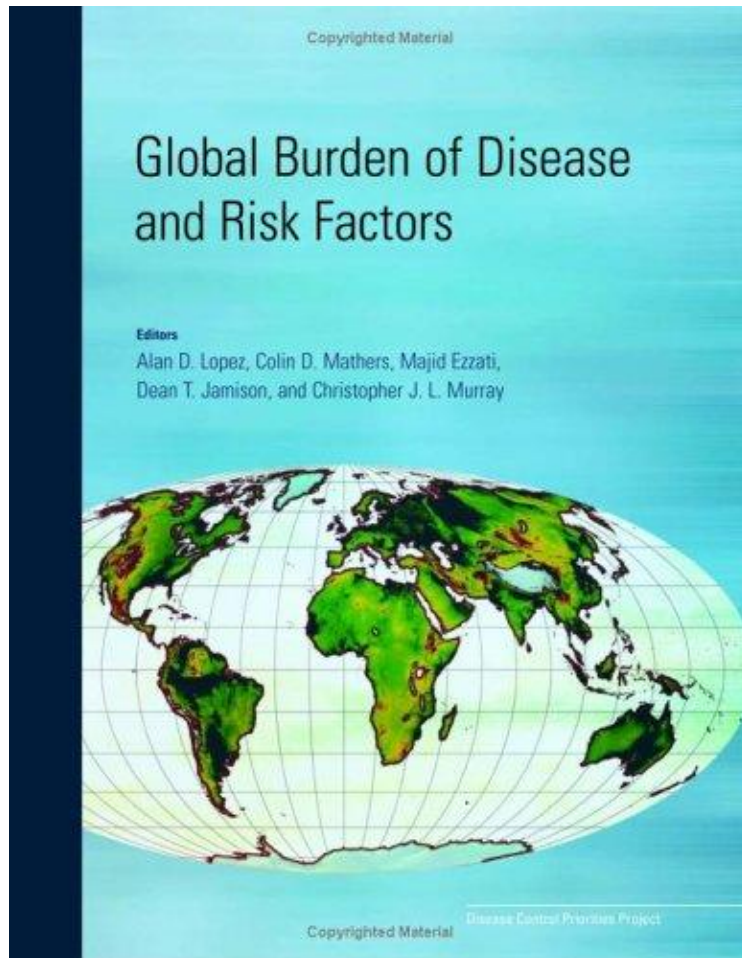# Need single metric for comparison

# Ranking of Global Mortality 2004

| | Cause of Death | % |
|---|---|---|
| 1 | Lower respiratory tract infections | 11.2 |
| 2 | Coronary Heart disease | 9.4 |
| 3 | **Diarrhoeal disease** | 6.9 |
| 4 | HIV/AIDs | 5.7 |
| 5 | Stroke and cerebrovascualr disease | 5.6 |
| 6 | Chronic obstructive pulmonary disease | 3.6 |
| 7 | Tuberculosis | 3.5 |
| 8 | Neonatal infections | 3.4 |
| 9 | Malaria | 3.3 |
| 10 | Premature and low birth weight | 3.2 |

# Morbidity versus Mortality

# Global **Burden** of Disease



Global Burden of Disease and Risk Factors

Editors
Alan D. Lopez, Colin D. Mathers, Majid Ezzati,
Dean T. Jamison, and Christopher J. L. Murray

In 1992 the World Bank commissioned the initial GBD

Need a single, holistic measure of overall population health

Harvard School of Public Health and World Health Organisation

# Disability Adjusted Life Year

- Takes into account mortality and morbidity

- Measurement of the gap between current health status & ideal situation of living into old age free of disease & disability

- 1 DALY is one lost year of 'healthy' life

Murray CJL, Lopez AD, eds: *The Global Burden of Disease: A comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020*. Cambridge, MA: Harvard University Press on behalf of the World Health Organization and the World Bank; 1996

# Calculation of DALYs

## Hypothetical population
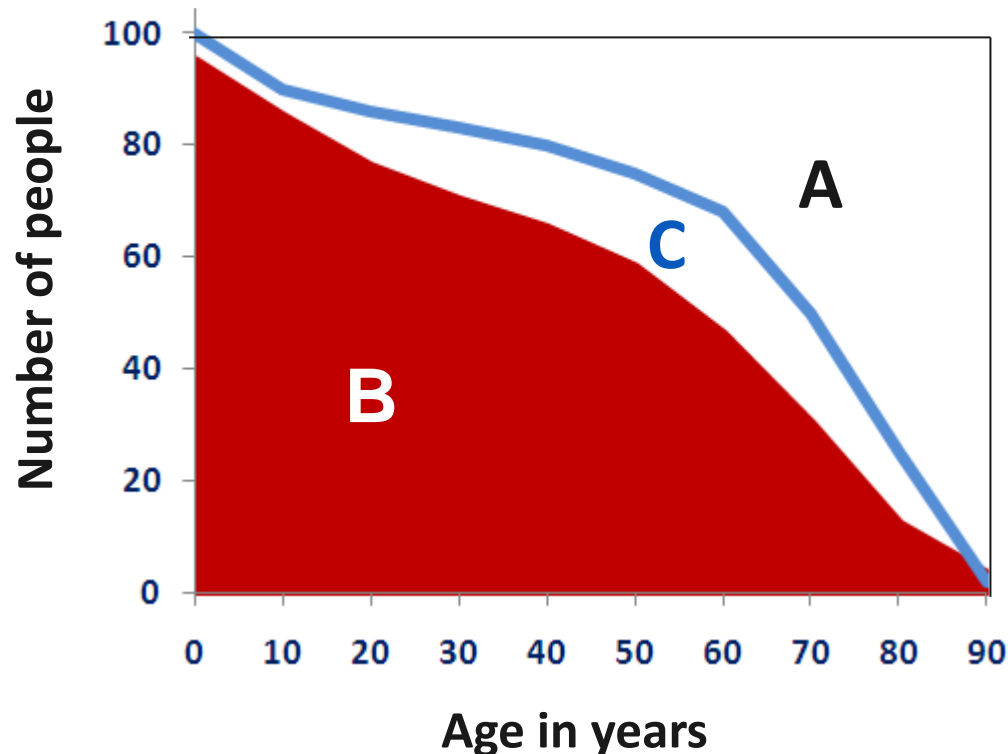


**A**  Deaths

**B**  Time spent in perfect health

**C** Time spent in less than perfect health

**D**ALY = A + **C**

# DALY Calculation
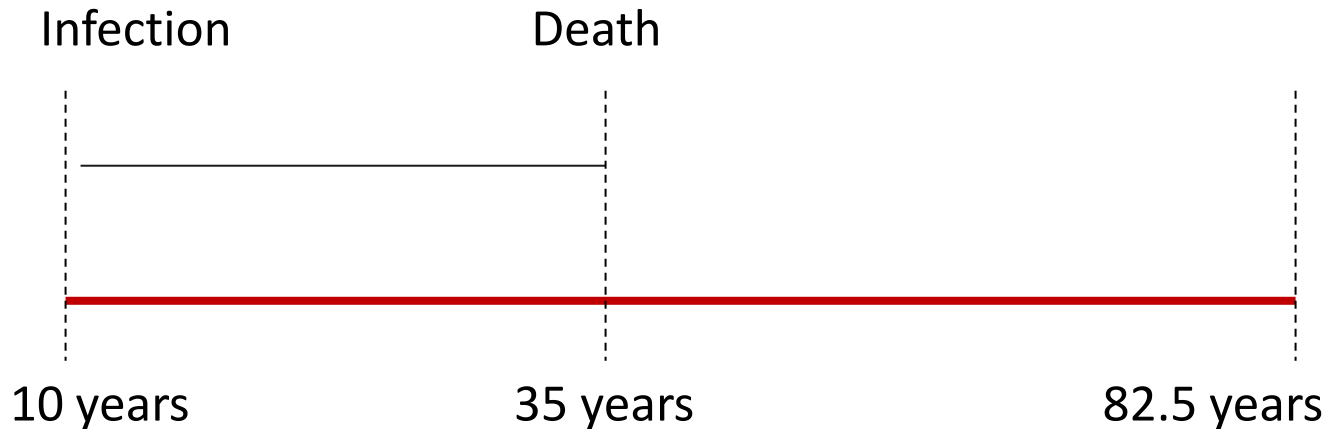
**Disability Adjusted Life years** = Death + Years lived in less than perfect health

= Years of Life Lost + Years lost to Disability

= YLL + YDL

# DALY Worked Example

Mariam from Burkina Faso with Schistosomiasis

Infection        Death

10 years        35 years        82.5 years

**YLL** = (82.5 − 35)
= 47.5 years

**YLD** = Years Lived with a disability (25) x Disability weighting (0.55)
= 13.75 years

**DALY** = **YLL** (47.5) + **YLD** (13.75)
= 61.25 years

# Information needed for DALYs

- Life expectancy

- Incidence of diseases by age category

- Sequelae of disease

- Duration of each sequelae

- Mortality rate by age category

- Disability weight

# Sequelae in Leptospirosis
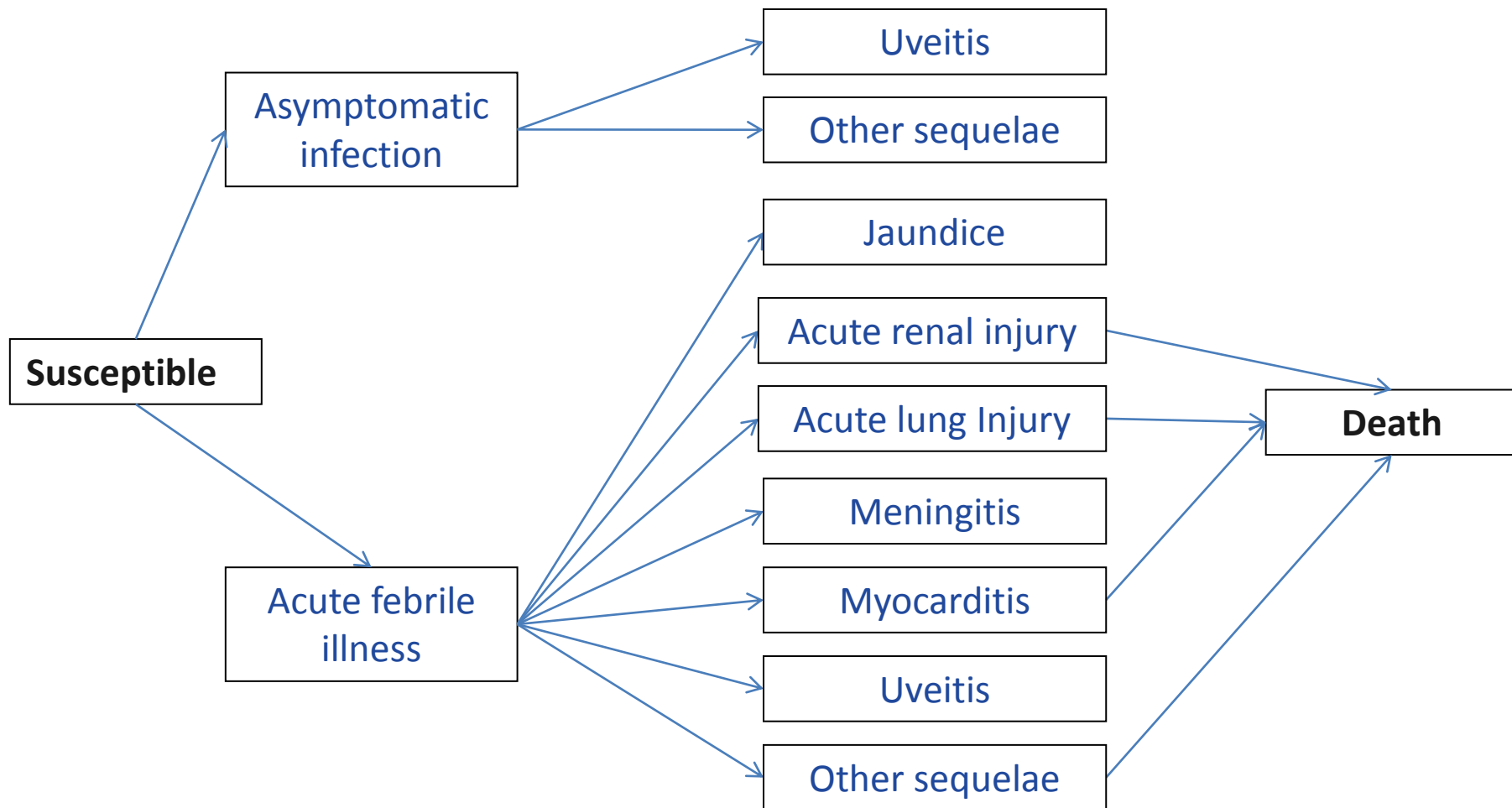
# Disability Weighting

Expert Panel convened August 1995 Geneva

Rated and discussed of each condition
using Person Trade Offer method  in 2 ways

- Extending the life of a person with the specified condition
- Curing the disability of people  with the specified condition

# Disability Weighting

**Compare intervention to extend the lives of**

**A** 1000 healthy individuals for one year
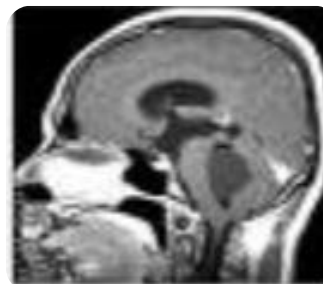**B** n(≥1000) blind individuals for one year and

**A** 1000 health individuals for one year
**B** Cure the disability of n blind individuals who will live one year

# Disability Weighting

| Disability Class | Severity Weight |
|:---:|:---:|
| 1 | 0.00 - 0.02 |
| 2 | 0.02 - 0.12 |
| 3 | 0.12 - 0.24 |
| 4 | 0.24 - 0.36 |
| 5 | 0.36 - 0.50 |
| 6 | 0.50 - 0.70 |
| 7 | 0.70 - 1.00 |

# Disability Weighting

| Disability Class | Severity Weight | Indicator condition |
| --- | --- | --- |
| 1 | 0.00 - 0.02 | Vitiligo on face, **weight-for height less than 2 SDs** |
| 2 | 0.02 - 0.12 | **Watery diarrhoea**, severe sore throat, severe anaemia |
| 3 | 0.12 - 0.24 | **Radius fracture in a stiff cast**, infertility, erectile dysfunction, rheumatoid arthritis, angina |
| 4 | 0.24 - 0.36 | Below- the-knee amputation, **deafness** |
| 5 | 0.36 - 0.50 | Recto-vaginal fistula, mild mental retardation, Down-syndrome |
| 6 | 0.50 - 0.70 | **Unipolar major depression**, blindness, paraplegia |
| 7 | 0.70 - 1.00 | Active psychosis, dementia, **severe migraine**, quadriplegia |

# Age weighting
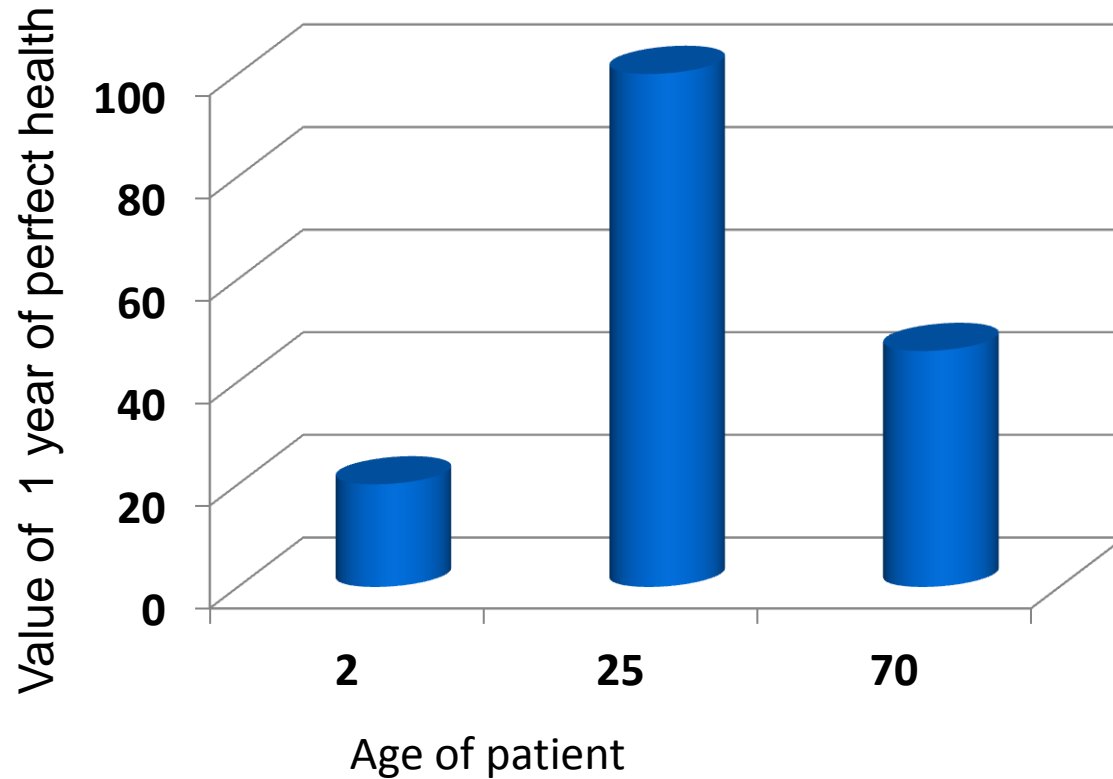


*Jonannesson and Johanasson 1996*

# Age Weighting

- Human capital and net producers

- Provision of well being to others

- Hampshire principle [1]

*"those who society assigns clear responsibility of caring directly for the most vulnerable will be valued"*
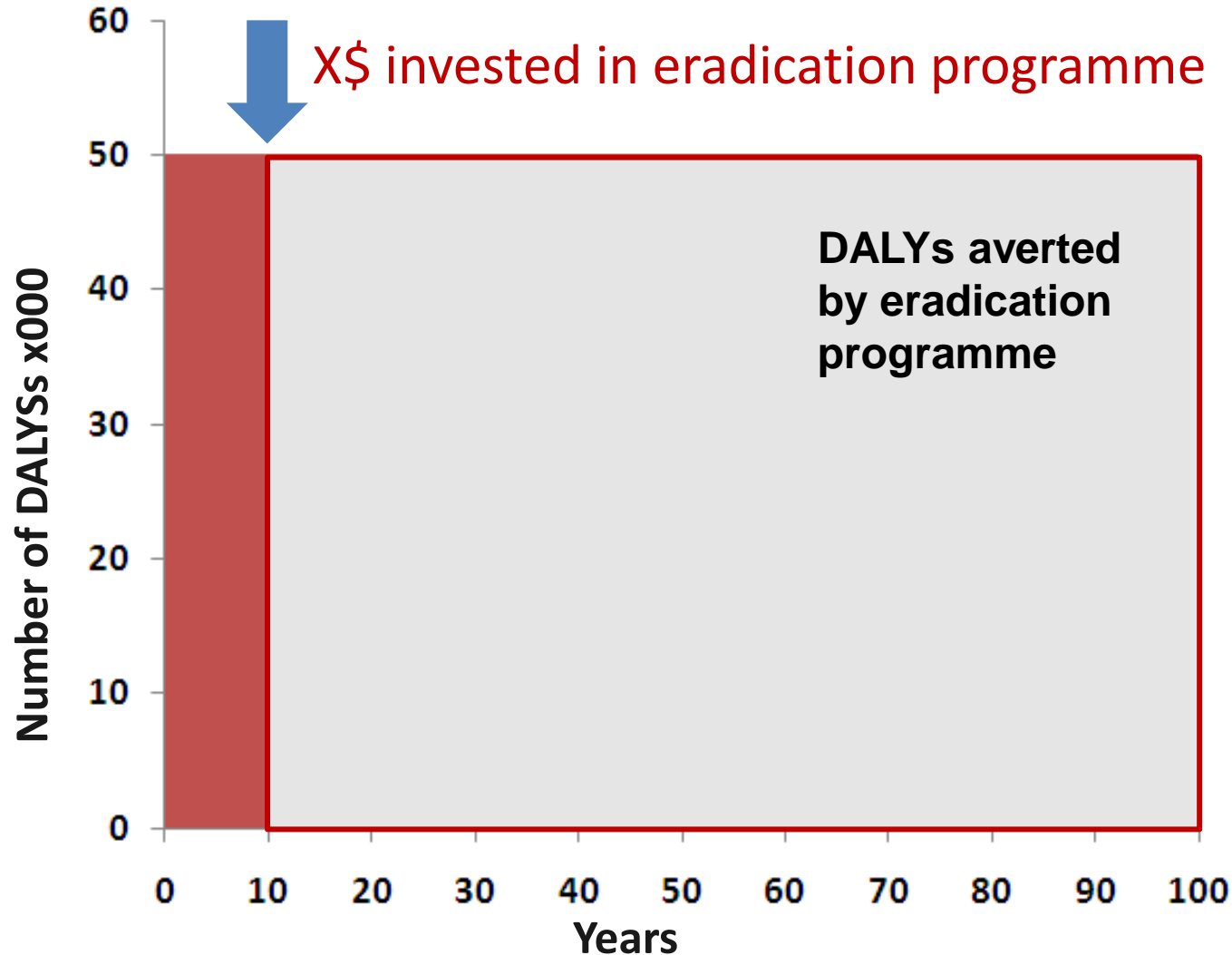
1 Hampshire et al 1989
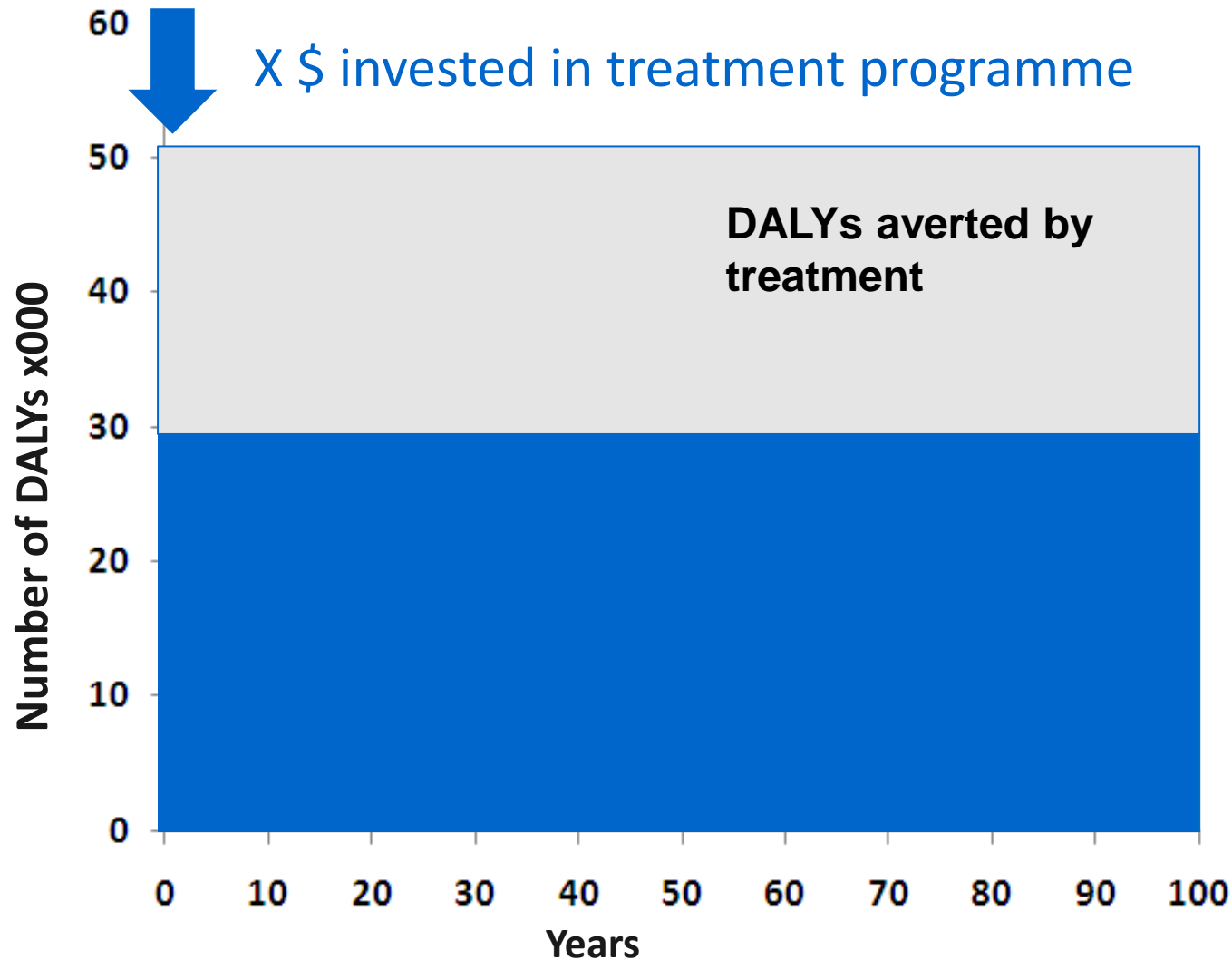
# **Discounting**

- Financial model

- £100 today  has a greater value than £100 received in a year

- Health can't be re-invested

- Eradication/ Research paradox

# Eradication paradox



X$ invested in eradication programme

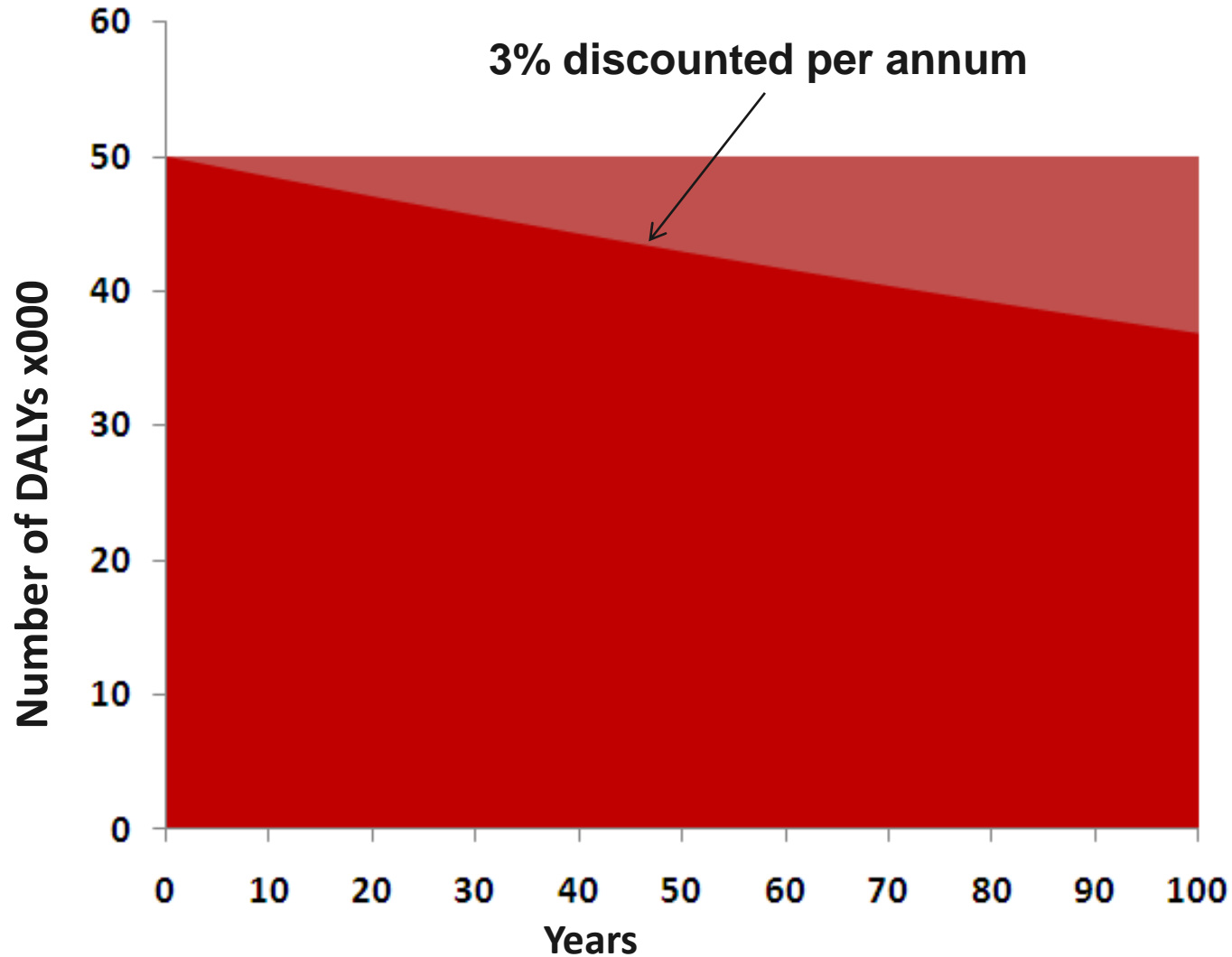DALYs averted by eradication programme

Number of DALYS x000

Years

# Eradication paradox



X $ invested in treatment programme

**DALYs averted by treatment**

Number of DALYs x000

Years

# Eradication paradox

Eradication

All investment in
eradication programme

Treatment

All investment in treatment

# Discounting

**Imperial College**
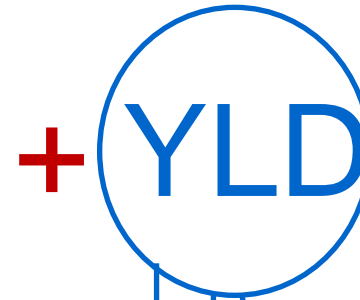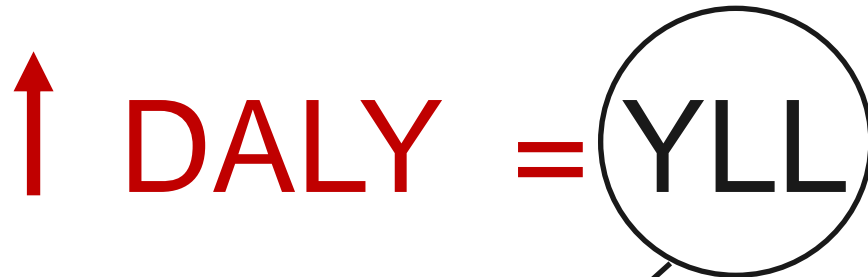London

# Discounting & Age weighting

SCI
Schistosomiasis
Control Initiative

No deaths x yrs lost against standard          Incidence x duration x DW

↑ DALY = (YLL) + (YLD)

High number deaths

Young adult deaths

High incidence

Sequela +++

High DW

Long duration

# Global Burden of Disease Study 2010

"The GBD 2010 study will develop improved methods to make full use of the increasing amount of health data, particularly from developing countries, and will include a comprehensive and consistent revision of disability weights. The study will also assess trends in the Global Burden of Disease from 1990 to 2005".

BILL & MELINDA GATES foundation

# The 10 Leading Causes of Life-Years Lost to Disability and Premature Death in low income countries
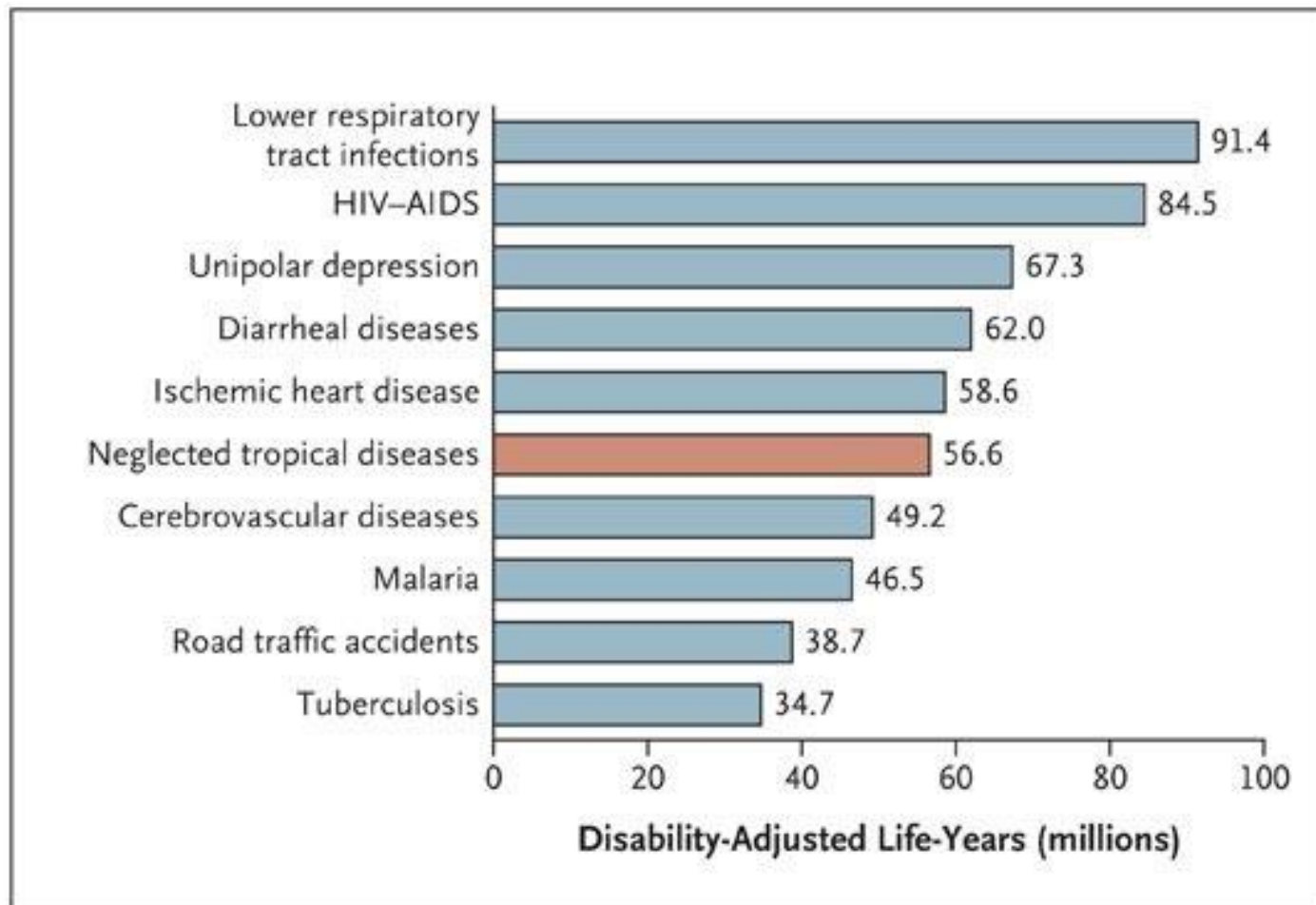
# Mortality vs DALY Burden

| | Cause of Mortality |
|---|---|
| 1 | Lower respiratory tract infections |
| 2 | Ischemic Heart disease |
| 3 | **Diarrhoeal disease** |
| 4 | HIV/AIDs |
| 5 | Stroke and cerebrovascular disease |
| 6 | Chronic obstructive pulmonary disease |
| 7 | Tuberculosis |
| 8 | Neonatal infections |
| 9 | Malaria |
| 10 | Premature and low birth weight |

**One IVF course = £2,700**
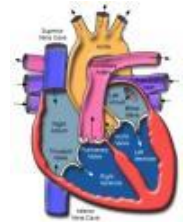
One-third of a cochlear implant

1 heart bypass operation

11 cataract removals

150 MMR vaccinations

One-thousandth of a
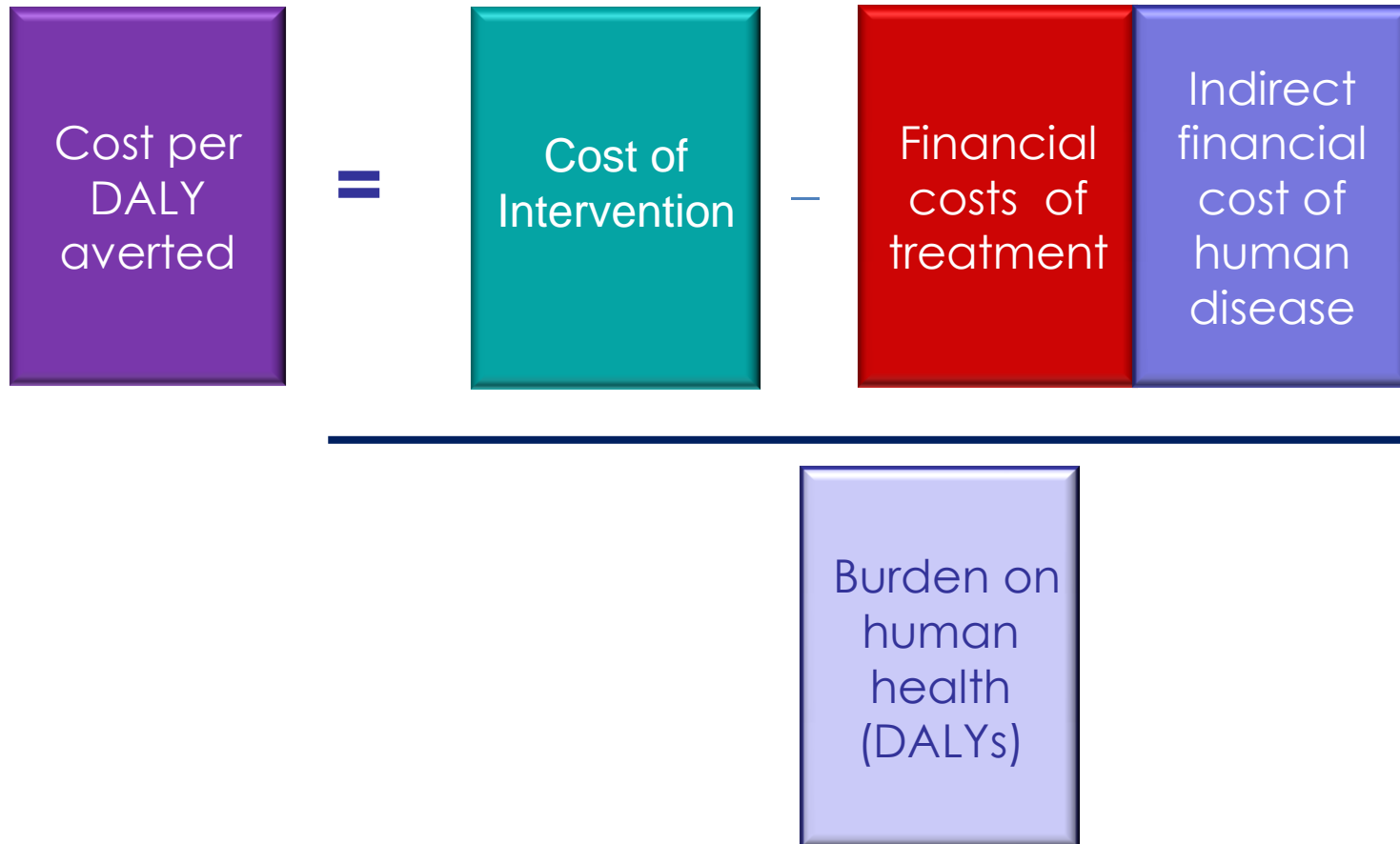Challenger 2 military tank

Borrowed from Nancy Devlin, City University

# Use of DALYs and Burden of Disease indicator

Net Burden of human disease = Burden on human health (DALYs) + Financial costs of treatment + Indirect financial cost of human disease

# Use of DALYs and Burden of Disease indicator

$$\text{Cost per DALY averted} = \frac{\text{Cost of Intervention} - (\text{Financial costs of treatment} + \text{Indirect financial cost of human disease})}{\text{Burden on human health (DALYs)}}$$
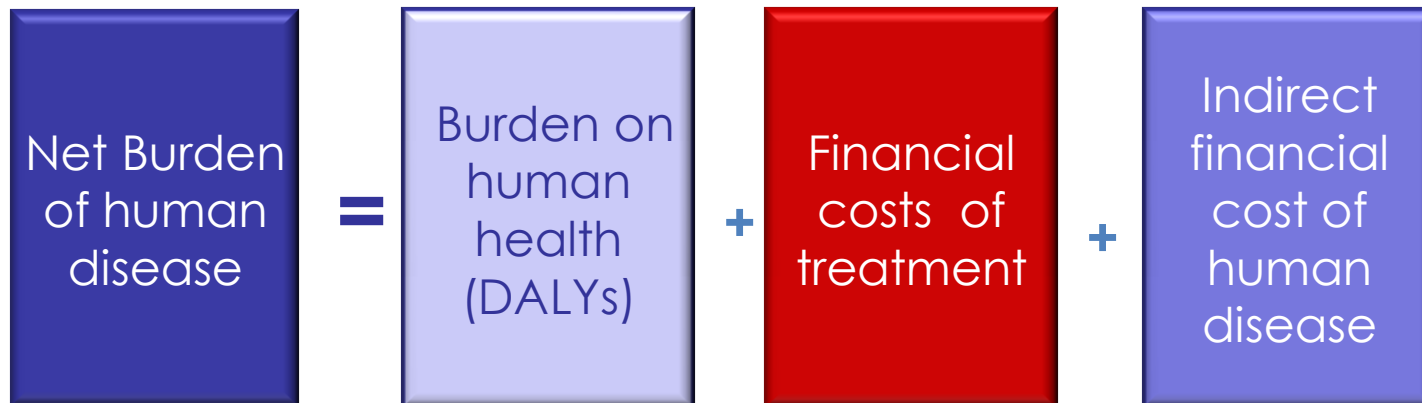
# Cost effectiveness of Interventions

| Disease | Interventions | Cost per DALY averted $ |
|---|---|---|
| HIV | Low cost measures | 6–377 |
| | High cost measures | 673–1494 |
| Malaria | Insecticide-treated bed nets&insecticide Residual household spraying IPT during pregnancy | 2-24 |
| Depression | Episodic treatment with anti - depressant drug and maintenance psychosocial treatment | 1003–1449 |
| Diarrhoea | Oral rehydration therapy Rotavirus or cholera immunisation | 500–158 |

*Laxminarayan  et al  Disease Control Priority Project Lancet 2006*

# Thresholds for DALYs averted

If $ per DALY averted

< GNI per capita = highly Cost Effective

1-3 times GNI per capita = Cost Effective

> 3 times GNI per capita = not Cost Effective

*WHO Commission on Macroeconomics and Health Studies 2000*

# Thresholds for DALYs averted
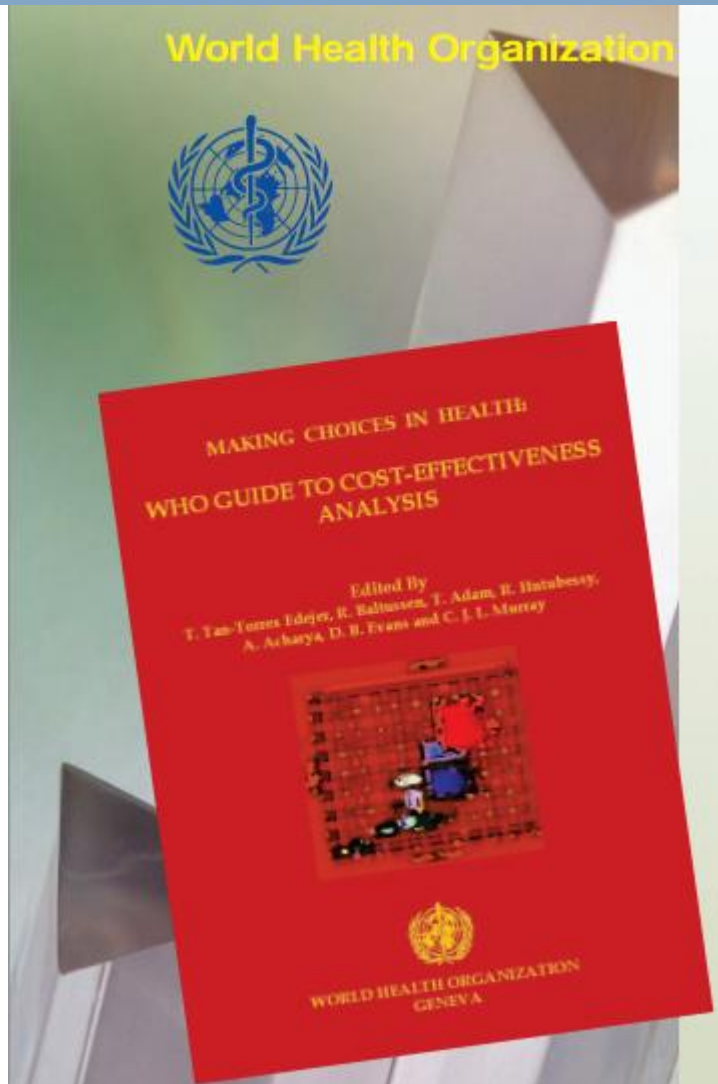
**1-3 times GNI per capita = Cost Effective**

Norway*   $86,440 – $259,320

Burundi *   $150 - $450

*  *Atlas Method 2009 World Bank*

# WHO – CHOICE
## CHOosing Inverventions that are Cost Effective

- A critical component of health financing policy is to ensure the available resources are used equitably and efficiently.

- WHO-CHOICE contributes to this evidence base by assembling regional databases on the costs, impact on population health and cost-effectiveness of key health interventions.

# Exercise

- You have been promoted ! You are now the Finance Minister.

- You came to power on a platform of improving equity and economic prosperity

- Discuss the other issues that would have to be considered around choosing between intervention for diarrhoea and depression especially in the light of the components of the DALY calculation

- Please read the DALYs : Efficiency versus Equity paper provided.

## Any Questions ?
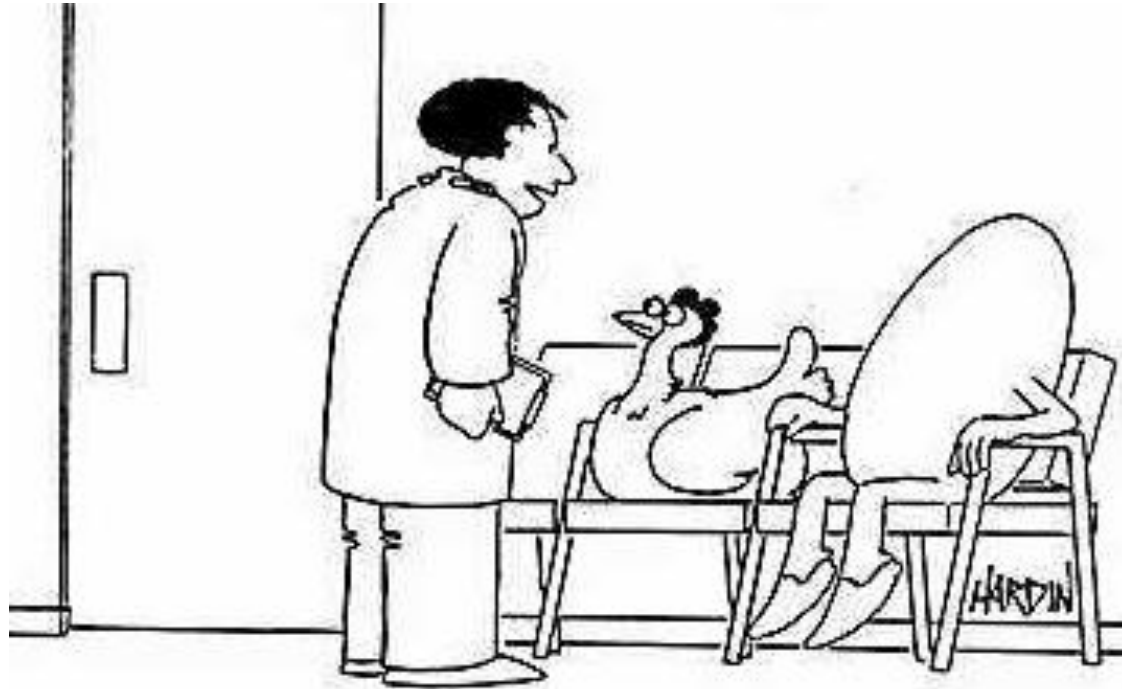


"who was first?"

# Why GBD valuation underestimate the burden of NTDs



- Problems with assigning "average" disability weight

- Poverty as a strong effect modifier worsens the impact and restricts access to care

King & Bertino 2008

# Why GBD valuation underestimate the burden of diseases of poverty

- Lack of accurate measurement of chronic and subtle morbidities

- Categories within the GBD are based on a classification system that includes both
  - etiological and
  - undifferentiated  syndromes e.g. anaemia, infertility

- By disaggregating the complications from their infectious causes leads to a unrealistically low disability weight

King & Bertino 2008

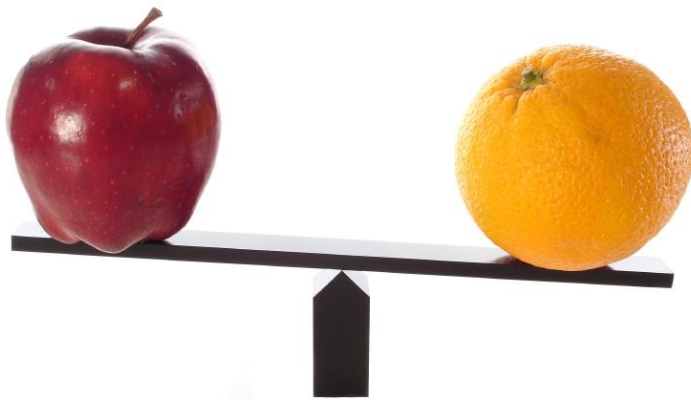# Why GBD valuation underestimate the burden of diseases of poverty
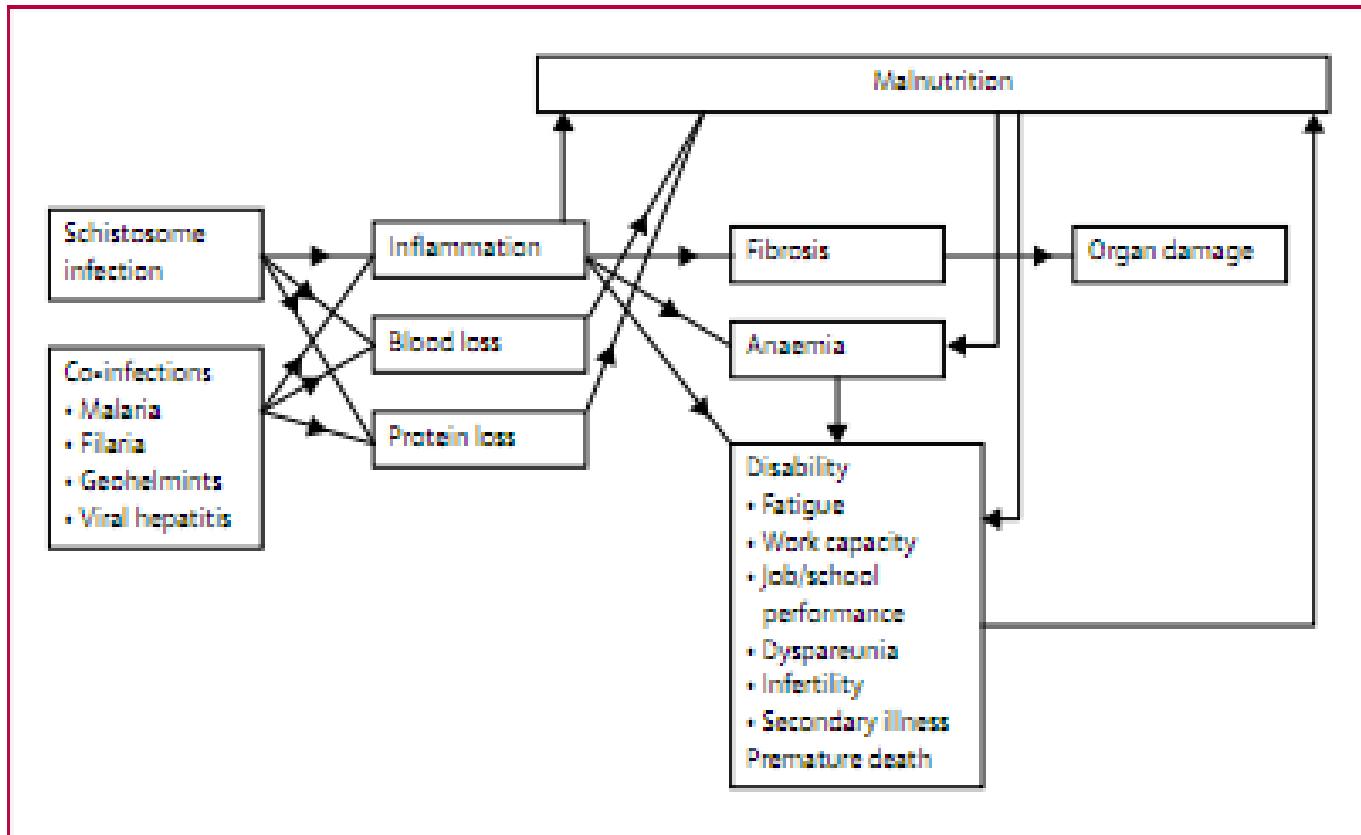
Re-adjustment of WHO estimates of 0.5% disability weight assigned to schistosomiasis to 2-15%

King et al 2005

# Why GBD valuation underestimate the burden of diseases of poverty

- Problems associated with assigning "average" disability weight

Age weighting inappropriate in developing world setting

Polyparasitism makes disaggregating attributable risk difficult

Radical change to measure of disease burden

*King & Bertino 2008*

# How best to measure the health?

## DALYS

- Estimate the years of life lost from disease & years lived with a disability

- Calculated using a number of parameters including
  - A weighted combination **of life expectancy**
  - **Disability weights**
  - **Age weighting**
  - **Discounting**

- Are agreed by an expert technical committee

## QALYS

- Life expectancy and a measure of the quality of the remaining life-years.

- Generated from individual ability to function in different dimensions.
- **Mobility**
- **Pain/discomfort**
- **Self-care**
- **Anxiety/depression**.
- **Usual activities**

- Based on society assessment of disease effect on life

# Other considerations

- Extent to which investment serves society as a whole
- The extent to which the investment produces additional benefits
- The capacity to deliver the proposed services
- The ability to change budget priorities and associated
- Equity considerations