Every 45 seconds a child dies of malaria
Human migration from Africa

Courtesy Wellcome Trust
Tertian malaria fever periodicity
Alphonse Charles Laveran
1845-1922
Nobel Laureate 1909

Was the first to observe parasites in the red blood cells of a patient suffering from malaria
Plasmodium falciparum in peripheral blood

Field, JW & Shute PG The Microscopic Diagnosis of Human Malaria
Sir Ronald Ross FRS, Nobel Laureate 1857-1944

Discovered that the malaria parasite is transmitted by mosquitoes.
Anopheles mosquito feeding

Courtesy Wellcome Trust
Species of malaria parasite in humans

*Plasmodium falciparum*. Malignant tertian malaria

*Plasmodium vivax*. Benign tertian malaria

*Plasmodium malariae*. Quartan malaria

*Plasmodium ovale*. Ovale tertian malaria

**Plasmodium knowlesi*. Quotidian malaria

* 1922                      ** 1932 and 2004
The life-cycle of *Plasmodium vivax* in man & the mosquito. (after Vickerman and Cox, 1967)

1. **Exoerythrocytic Schizogony**
   - Hypnozoites remain in liver, *P. ovale* & *P. vivax*.

2. **Erythrocytic Schizogony**
   - Merozoites penetrate red cells.
   - Schizonts reinvade red cells.
   - Merozoites.

3. **Gametocytes**
   - Gametocytes take into mosquito with blood meal.
   - Macrogametocyte & microgametocyte.
   - Exflagellation of microgametes.

4. **Fertilization**
   - Ookinete penetrates midgut wall of mosquito to develop into oocyst.

5. **Sporogony**
   - Oocyst ruptures to liberate sporozoites.

6. **In Man**
   - Sporozoite penetrates liver cell.
   - Sporozoites injected with saliva of mosquito.

7. **In Mosquito (Anopheles)**
   - Sporozoites in salivary gland.

This diagram illustrates the complex life cycle of *Plasmodium vivax* within its host and vector, highlighting the critical stages of schizogony, gametogenesis, fertilization, and sporogony.
Global Malaria Eradication Programme: the beginning

1955 Initiated by WHO. Aim: Global eradication of malaria

Weapons available:

Drugs: Quinine (1850s)
Chloroquine (1940s)
Pyrimethamine (1950s)
Proguanil

Insecticides: DDT (1940s)
Pyrethrum (1900s)
Global Malaria Eradication Programme: the end

1969 Abandoned

- Resistance to antimalarial drugs
- Resistance to DDT and other insecticides
- Population movements
- Other priorities
- Wars and conflicts
- Social and political upheaval
- Lack of sustained funding
- Inflexibility

Environmental damage caused by DDT
The book that destroyed DDT

Rachel Carson’s book, *Silent Spring*, drew the attention of the public to the dangers of environmental pollution. Unfortunately this also led to the banning of the manufacture and use of DDT with disastrous consequences for the control of malaria and other insect-borne diseases.
Roll Back Malaria


Aim: To halve cases of malaria by 2010 by ensuring prompt access to treatment giving priority pregnant women and infants providing insecticide-impregnated bednets
The World Malaria Report summarises information received from 106 malaria-endemic countries/areas.
Deaths from malaria per 1000 population

Fig. 3.8 Estimated deaths from malaria per 1000 population, 2006
Every 45 seconds a child dies of malaria

“SMS for Life”
Improving medicine access through innovation
A Roll Back Malaria partnership initiative
Deaths from malaria 1980-2010 (thousands)
The current armoury

7100 malariologists
+ innumerable health personnel, field workers etc.
New diagnostics
Antimalarial drugs
Insecticides
Funding agencies
Involvement in malaria elimination

- Scientists and clinicians
- Sociologists and economists
- Politicians and decision makers
- Funders and providers
Current antimalarials

4-aminoquinolines
• Chloroquine 1934-1947
• Amodiaquine 1977-1980

8-aminoquinolines
• Primaquine 1944-1952

4-methanolquinalones
• Quinine (quinidine) c. 1638-1850
• Mefloquine (Larium) 1970-1974

Antifolates
• Pyrimethamine 1944-1952
• Proguanil (+ atovaquone Malarone) 1944-1952
• Atovaquone 1992-1998

Antimicrobials
• Doxycycline

Artemisinin derivatives
Artemisinin
Bednet
Bednets

Non-treated Bednets

Insecticide Treated Nets (ITN)

Long lasting Insecticidal Nets (LLIN)

- Rectangular or conical
- Coloured (dark green, dark blue, light green, light blue, white)
- Cotton, polythene, polyester, nylon
- Pyrethroids (Deltamethrin, Permethrin)
Acceptability of bednets

- Cost £5-£7 (Cost to us £10-15)
- Willingness to pay
  - Ethiopia £2.0
  - Kenya £0.40

Shape: Rectangular > conical
Colour: Green > blue > white. Dark > light
Material: Cotton > polyester > nylon
Actual usage 8% (Chad)-82% (Mali)
Waiting for the vaccine
Fantasies about eradication should not be allowed to derail realistic approaches to this problem.

Available resources should be focused where transmission can be permanently reduced within African resources in those countries which have stable and democratic governments.

Appropriate local strategies should be developed in ecological zones across the continent which match transmission patterns.

Malaria transmission can be reduced to levels that are tolerable and sustainable.
Home based management of malaria (HMM)

Introduced in 2005

• Selecting and training community health workers as Community Medicine Distributors

• Ensuring availability of appropriate drugs in labelled blister packs with instructions

• Education of mothers and other carers

• Ensuring 24 hour access ‘close to home’

• Diagnosing malaria

• Prescription of appropriate drug
Cost of intervention

Diagnostic test £0.37-£1.60
Treatment £0.80-£2.0
Bednet £5.00
Impregnated bednet £6-7
<table>
<thead>
<tr>
<th>Disease</th>
<th>Deaths</th>
<th>Cost of Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>1.8 million</td>
<td>£18,000</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>1.7 million</td>
<td>£5,000</td>
</tr>
<tr>
<td>Drug resistant</td>
<td></td>
<td>£50-70,000</td>
</tr>
<tr>
<td>Malaria</td>
<td>660,000</td>
<td>£2.0</td>
</tr>
</tbody>
</table>
Reasons to be hopeful

- Malaria cannot pass directly from person to person
- Malaria is not a disease of poverty
- Malaria is not a disease associated with unsanitary conditions
- Malaria is easy to prevent
- Malaria is easy to diagnose (c.f. TB, HIV)
- Malaria is easy to treat (c.f TB, HIV)
Global Fund to Fight AIDS, Tuberculosis and Malaria

2002 Established (Gates Foundation)

Aim £18 bn from 54 countries

2011 £14 bn disbursed

2012 £21-25m misappropriated (0.15-0.17%)

2012 Frozen until 2014