Turning the Worm
The Eradication of Guinea Worm Disease in West Africa

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Member, Unicef/WHO Interagency Technical Team for Dracunculiasis Eradication, Ouagadougou 1992-5
Transmission cycle
• The cycle is completed when people collect water containing infected Cyclops and drink it.
• The Cyclops is killed by stomach acid and the worm penetrates the gut wall and moves to the subcutaneous tissues.
• Male and female have sex; The male worm dies, the female grows.
• The female releases fluid containing larvae.
• This causes a blister to form, from which the female worm emerges.
• Thousands of larvae are released; In water they are swallowed by Cyclops.
History
William Dampier;
‘Pirate and Hydrographer’
Surgeon-Major James Africanus Beale Horton

- The first west African to be trained in the UK as a doctor
Epidemiology
Agricultural activities

Harvest
Cases

Rainfall
Incidence (%)

Sowing
Weeding

Months

Rainfall (mm)
## Eradicability

<table>
<thead>
<tr>
<th></th>
<th>Malaria</th>
<th>Smallpox</th>
<th>Polio</th>
<th>Dracunculiasis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No mobile vector</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>No animal reservoir</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Host</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited carrier state</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Easy diagnosis</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td><strong>Distribution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited endemic area</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td>Seasonal transmission</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
</tr>
<tr>
<td>Threat to westerners</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective drugs exist</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Prevention cheap &amp; complete</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Needs no behaviour change</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Adapted from Hopkins (1983)
Countries achieving zero indigenous cases of Dracunculiasis

- Uzbekistan (1932)
- Iran (1972)
- Pakistan (1994)
- India (1997)
- Senegal, Yemen (1998)
- Chad, Cameroun (1999)
Interventions: cyclopicide (Temephos)
Water sources in an endemic village in Burkina Faso

<table>
<thead>
<tr>
<th></th>
<th>Wells</th>
<th>Streams</th>
<th>Large ponds</th>
<th>Small watering ponds</th>
<th>Small natural ponds</th>
<th>Small man-made ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number in village</td>
<td>47</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Diameter (m)</td>
<td>2</td>
<td>10</td>
<td>90-200</td>
<td>17-45</td>
<td>7-15</td>
<td>4-9</td>
</tr>
<tr>
<td>Depth (cm)</td>
<td>&lt;500</td>
<td>250</td>
<td>100-130</td>
<td>45-60</td>
<td>25-30</td>
<td>30-55</td>
</tr>
<tr>
<td>Potential GW source?</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>% of GW patients using them</td>
<td>-</td>
<td>-</td>
<td>7.3</td>
<td>1.6</td>
<td>4.1</td>
<td>30.2</td>
</tr>
</tbody>
</table>

Problems with Temephos

• Difficult access in rainy (transmission) season

• Too many ponds per village – Chippaux treated the wrong ones

• Measuring volume
  – Takes half a day
  – Rain dilutes the Tenephos

• Ponds are often too large (> 500m³) for dispersal

• Organic matter absorbs Tenephos

• Danger of false sense of security

• Diverts staff and vehicles

• “Limited shelf-life”
Interventions: water supply
Guinea worm and village size in Zou Province, Benin

Source: 1988 national search for cases
Hand pumps and Guinea worm in 30 Provinces of Burkina Faso

Source: National case search, 1990
Dracunculose dans 4 provinces
L’APPROVISIONNEMENT EN EAU POTABLE AU NIVEAU DES QUARTIERS QUI CONSTITUENT UN VILLAGE
Access to safe water
Boussouma, Burkina Faso

Percentage of neighbourhoods further than a given distance from safe water
Water supplies will not control Guinea worm if they:

- Are in the wrong village
- Are too far away
- Are not working
- Are not used
- Are not used exclusively
Interventions: health education
Guinea worm in Enugu State, Nigeria: Impact of boreholes and health education
Community-based surveillance

- Conventional (passive) surveillance - people that are ill reporting their cases themselves
- Does not work in this case
- It has to be active surveillance - looking for the cases
- It has to be community based
Characteristics of community-based surveillance:

Active, with

- Monthly home visits
  - By volunteers
  - Who know those visited
  - Supervised monthly

The data should be used as near the village as possible
Significant risk factors for Guinea worm (from a multivariate regression model)

- We don’t know why some people get Guinea worm more often than others
- Surveillance is exactly the right tool for the health educator
Community-based surveillance in Africa
Village with monthly reporting of GW cases
Decline of Dracunculiasis cases in selected countries 1987-1994
Evaluation results
# Evaluation of Burkina Faso GWEP

Sensitivity of the surveillance system in the endemic villages known in 1990

<table>
<thead>
<tr>
<th>Village “endemic” according to DPS?</th>
<th>Cases found in survey</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>54</td>
</tr>
</tbody>
</table>

Sensitivity = \frac{18}{19} = 95\%
Evaluation of Burkina Faso GWEP (2)

Sensitivity of the surveillance system in the newly endemic villages

<table>
<thead>
<tr>
<th>Village &quot;endemic&quot; according to DPS?</th>
<th>Cases found in survey</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Yes</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>No</td>
<td>8*</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>19</td>
</tr>
</tbody>
</table>

Sensitivity = 11/19 = 58%

* In 3 of these 8 villages there was only a single case; in 6 villages, there were 3 cases or less
Health education and knowledge of GW prevention in 26 villages of Tillabery, Niger

% knowing to filter water

% attended health education

$r = 0.84$  (Approx. 10 households visited/village)
Health education and knowledge of GW prevention in 26 villages of Tillabery, Niger (2)

- Be careful about the first question
Dracunculiasis in Ghana, 1989-2004

Year

No. of cases

1989 179,556
1990 123,793
1991 66,697
1992 33,464
1993 17,918
1994 8,432
1995 8,894
1996 5,611
1997 4,739
1998 7,402
1999 9,027
2000 5,473
2001 8,921
2002 9,027
2003 8,290
2004 7,275
Why did Ghana perform poorly?

- Ethnic conflict in N. Region
- Cuts in funding from major partners
- Sector-wide approach » delayed release of funds
- Integration » all health vehicles pooled
- Transfer of environmental health staff to Ministry of Local Government
### Results of Ghana evaluation in 4 problem districts, 2005

#### Surveillance sensitivity

<table>
<thead>
<tr>
<th>Cases recorded/found (sensitivity %)</th>
<th>68/122 (56%)</th>
</tr>
</thead>
</table>

#### KAP survey (N = 344)

<table>
<thead>
<tr>
<th>Item</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knows how to prevent GW</td>
<td>319</td>
<td>(93%)</td>
</tr>
<tr>
<td>Obtains filters free of charge</td>
<td>344</td>
<td>(100%)</td>
</tr>
<tr>
<td>Drinks safe water when in fields</td>
<td>326</td>
<td>(95%)</td>
</tr>
<tr>
<td>Knows name of VV</td>
<td>338</td>
<td>(98%)</td>
</tr>
<tr>
<td>Visited last week by VV/Red Cross</td>
<td>251</td>
<td>(73%)</td>
</tr>
<tr>
<td>Attended HE session in last 12 months</td>
<td>229</td>
<td>(67%)</td>
</tr>
<tr>
<td>Would go to VV for treatment of GW</td>
<td>327</td>
<td>(95%)</td>
</tr>
</tbody>
</table>
The next phase
‘Classical Approach’

- Water supply
- Distribution of filters
- General health education (HE)
- Monthly case surveillance
- PERSONAL PROTECTION
Case containment strategy

- Early case detection (<24hr)
- Occlusive bandage
- Case history
  - Contact with ponds
  - Travel
- HE to patient & family
- Support and sanctions
- Inform public of contaminated ponds
- Confirm filter coverage
- Notification for:
  - Confirmation of report
  - Abate treatment
  - etc.
- POND PROTECTION
After we get rid of the worms
<table>
<thead>
<tr>
<th>Name</th>
<th>Date of birth</th>
<th>Sex</th>
<th>Address</th>
<th>Immunizations</th>
<th>Remarks eg. Absent (where?) Died (date of death?)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>DTP/ polio</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>G</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>


Some existing community-based surveillance systems

<table>
<thead>
<tr>
<th>Project</th>
<th>Longevity</th>
<th>Population (millions)</th>
<th>Annual cost /capita US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>India (ICDS)</td>
<td>8 years</td>
<td>165</td>
<td>0.60</td>
</tr>
<tr>
<td>India (TINP)</td>
<td>10 years</td>
<td>17</td>
<td>.020</td>
</tr>
<tr>
<td>Indonesia</td>
<td>13 years</td>
<td>60</td>
<td>0.72</td>
</tr>
<tr>
<td>Brazil (pastoral)</td>
<td>10 years</td>
<td>10</td>
<td>0.60</td>
</tr>
<tr>
<td>Brazil (Ceará)</td>
<td>6 years</td>
<td>4</td>
<td>1.20</td>
</tr>
<tr>
<td>Tanzania (JNSP)</td>
<td>10 years</td>
<td>0.28</td>
<td>0.30</td>
</tr>
<tr>
<td>Kenya</td>
<td>3 years</td>
<td>0.034</td>
<td>n.a.</td>
</tr>
<tr>
<td>Cameroon (GWEP)</td>
<td>3 years</td>
<td>0.042</td>
<td>0.28</td>
</tr>
</tbody>
</table>
“The development of improved methods for surveillance of neonatal tetanus and for monitoring TT coverage are major priorities.”
