Schistosomiasis: Challenges and Opportunities

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Challenges

• Continuing confusion about
  – What schistosomiasis *is*....
  – What schistosomiasis *does*....
  – What treatment *can and cannot accomplish*....
  – Who *needs to be treated*....
  – Why *transmission control will be required* to sustain any benefits of mass-drug administration
Opportunities

• Since 2003, regional and national control programs coming online in sub-Saharan Africa
• Inclusion in integrated control programs for multiple helminth infection NTDs
• Re-focus on lifetime impact, ecology of infection and disease
• Role of prevention in poverty reduction and attainment of Millennium Development Goals
Life Cycle of Schistosomiasis

- Egg
- Miracidium
- Cercaria
- Schistosomulum
- Adult
Life Cycle of Schistosomiasis

- Sewage Contamination
- Unsafe Water
What schistosomiasis is....

- Schistosomiasis is the disease caused by human infection by *Schistosoma* species parasites
What schistosomiasis was....

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What schistosomiasis was....

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What schistosomiasis *was*....

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What schistosomiasis was....

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- 1970s-1980s – conflation of *infection* and *disease* states
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- These often not significantly different from local controls, so most infection ‘asymptomatic’
- Focused only on advanced forms of disease
What schistosomiasis was... ~1989

Evaluation of public health impact of schistosomiasis

M. Tanner
Department of Public Health and Epidemiology, Swiss Hospital Institute, Basel, Switzerland


The relevance of schistosomiasis for public health

B. Gryseels
Laboratory for Parasitology and Institute for Tropical Medicine, University of Leiden, Leiden, The Netherlands.

Trop Med Parasitol 40:134, 1989

1. ‘Infection’ ≠ ‘Disease’
2. ‘Only about 1% have disease’
3. SO...not much of a public health problem
What schistosomiasis was... ~1989

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Reality Check

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‘people passing eggs’ are only part of the problem

*deVlas et al, Parasitology 1997*

*Fig. 1. Pocket chart to estimate true *Schistosoma mansoni* prevalences. By plotting observed single survey*
Infection occurs 2-3 years before eggs are detected.
Reality Check

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• Much of the sub-clinical morbidity was missed
The Impact of Infection is **Trans-Generational**

Geometric Mean anti-PRP IgG (µg/ml)

- **Mother not infected**
- S.h. or W.b. infected
- Haemophilus b Vaccination

Vaccine response deficit

**Kioko J & King CL, Parasite exposure in utero reduces protective immune response to Hib vaccination, submitted**
Reality Check

• Standard egg-count parasitology misses 40-60% of active infections
• Thus, most case-control studies were biased against detection of infection-related disease
• Much of the sub-clinical morbidity was missed
• The 1989 ‘no problem’ version of schistosomiasis....
Reality Check

• Standard egg-count parasitology misses 40-60% of active infections

• Thus, most case-control studies were biased against detection of infection-related disease

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• The 1989 ‘no problem’ version of schistosomiasis....

.... has no clothes!!!!
What schistosomiasis does....
It’s Not Only

Hepatosplenomegaly with *S. mansoni*

Hydronephrosis with *S. haematobium*
It’s Not Only

Hepatosplenomegaly with
S. mansoni

Classic Schistosomiasis

Hydronephrosis with
S. haematobium
But Also....

- Anemia
- Stunting
- Wasting
- Lack of fitness
- Cognitive impairment
- Infertility
- Genital lesions
Schistosomiasis - Egg granuloma impact is both **local** and **systemic**

**Damage and Scarring**

Pro-inflammatory cytokines in local tissues and in the circulation

- TNF, IL-6
Life Path of Schistosomiasis

- poor vaccine response
- anemia, growth stunting, lack of fitness
- loss of schooling, pain, organ dysfunction
- genital schistosomiasis, infertility
- advanced disease
Schisto Meta-analysis Summary

• Our former ‘objective’ morbidity standards (e.g., hepatosplenomegaly, hematuria) are just the tip of the disease/disability problem

• Pain, diarrhea, undernutrition, and anemia are clearly associated with infection, worse with heavier infection, and reversible, at least in part, with specific therapy

*King, Dickman and Tisch, Lancet 2005*
2010 Definition: Schistosomiasis

Schistosomiasis is a preventable, chronic inflammatory condition caused by present or previous infection with metazoan parasitic blood flukes of *Schistosoma* species.

Disease Case Definition—a person who has, or has previously had, infection with *Schistosoma* spp. parasites.

Estimated number of cases worldwide—442 Million
Cases, by region, in millions

<table>
<thead>
<tr>
<th>Region</th>
<th>1995</th>
<th>2005</th>
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<tbody>
<tr>
<td>Stage 1</td>
<td>390.5</td>
<td>411.2</td>
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<tr>
<td>Stage 2</td>
<td>26.6</td>
<td>29.1</td>
</tr>
<tr>
<td>Stage 3</td>
<td>1.83</td>
<td>1.98</td>
</tr>
<tr>
<td>All</td>
<td>418.9</td>
<td>442.2</td>
</tr>
</tbody>
</table>

**Diagram**

- Asia, central
- Asia, east
- Asia, south
- Asia, SE
- Caribbean
- Europe
- LatAm-Central
- LatAm-Tropical
- N Africa-Mideast
- N America-High income
- Oceania
- SSA-Central
- SSA-East
- SSA-South
- SSA-West
Lifetime exposure to chronic infection
Kenya 2010
Lifetime exposure to chronic infection
Kenya 2010

USA 1936
Lifetime exposure to chronic infection

- Malaria
- Hookworm
- Schistosomiasis
- Filariasis
Anemia, Stunting-- So What??
Anemia, Stunting-- So What??

These levels associated with
3-5% reduction in work output
60% reduction in peak workload capacity

Guyatt, Parasitol Today, 2000
Schistosomiasis

Effects / Affects

Poverty

Causes
Who Needs to Be Treated?

Based on continuing risk of reinfection and its associated morbidity, children should be treated every 1-2 years through adolescence.
How Long to Treat??

Meta-populations of worms, snails and humans within local environment means that re-emergence is unavoidable if ecosystem stays unchanged.
Transmission Control

- Significant morbidity of ‘re-worming’
- Net benefit will be substantial improvement in human capital
- Integrated Approaches to Control:
  - Education, behavior modification
  - Sanitation
  - Water supply
  - Habitat modification
  - Mollusciciding
Control USA, 1910 – 1950

- Hookworm and malaria control
- Micronutrient supplementation
- Agricultural extension programs
- Education
  - Home Economics
  - 4-H Clubs
  - Future Farmers of America
- Rural Electrification
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Schisto needs the same
Summary of Control Needs

• Sustained political will
• Decades long commitment
• National level programs
• Intersectorial and interagency collaborations
• Transmission control, progressing from reduction to elimination
Thank You
Features missed in GBD 1996

• Schistosomiasis is a chronic inflammatory disorder, much more like rheumatoid arthritis than typical High-Income Country infections

• Significant disabling disease occurs with all intensities of infection, not just with heavy infections  

• Disabling disease persists indefinitely after infection is cleared; serology and age are better measures of disease prevalence  
  Jia 2007

• Therefore, new assessment of disease states, and new calibration of affected population numbers

• 9-16 million instead of 1.5-1.7 million 1996 standard DALYs

• 25-36 million non-discounted DALYs