Modelling insights into Schistosomiasis control and elimination

Jaspreet Toor, James Truscott, Marleen Werkman, Hugo Turner, Ramzi Alsallaq, David Guranie, Charles King, Graham Medley, Deirdre Hollingsworth, Roy Anderson
Aims to develop mathematical models of NTD transmission dynamics and the impact of control measures
- Focus is on infections included in the London Declaration on NTDs
- Supporting NTD community and addressing priority questions
- Multiple models to increase robustness
- Funded by the Bill and Melinda Gates Foundation
- Includes schistosomiasis (CIFF funding)
- Led by Deirdre Hollingsworth

Schistosomiasis groups:
- Imperial College London: Jaspreet Toor, James Truscott, Roy Anderson
- Case Western Reserve University: Ramzi Alsallaq, David Gurarie, Charles King
- London School of Hygiene & Tropical Medicine: Graham Medley

Recent collections in CID and PLoS NTDs
Overview

◆ Recent work
  ◆ Are we on our way to achieving the 2020 goals for schistosomiasis morbidity control using current WHO guidelines?
  ◆ The design of schistosomiasis monitoring and evaluation programmes: The importance of collecting adult data to inform treatment strategies for *Schistosoma mansoni*.

◆ Current work
  ◆ Elimination for *S. mansoni*

◆ Future work
WHO strategy

◆ Goals based on prevalence of heavy-intensity infections in SAC
  ◆ Control morbidity due to schistosomiasis by 2020
    ◆ ≤ 5% SAC prevalence of heavy-intensity infection
  ◆ Elimination as a public-health problem by 2025
    ◆ ≤ 1% SAC prevalence of heavy-intensity infection

◆ Recommended treatment frequency based on prevalence in SAC

◆ Are current guidelines sufficient?

*SAC: 5-14 years of age

Worldwide prevalence of schistosomiasis in 2012 (WHO 2014).
Recommended adaptations

Current WHO guidelines (75% SAC coverage)

Toor J et al. (2018) Are we on our way to achieving the 2020 goals for schistosomiasis morbidity control using current WHO guidelines? CID.

*SAC: 5-14 years of age
M&E programmes

- Data typically collected from SAC as they are most likely to be infected
- Does the burden of infection in adults impact our recommended treatment strategies?


*SAC: 5-14 years of age*
Required coverage levels

High prevalence settings
(≥50% SAC baseline prevalence)

WHO goal of elimination as a public health problem


*SAC: 5-14 years of age*
Moving towards elimination

- Risk of recrudescence after stopping treatment
- Adult burden will impact coverage levels required to reach elimination
  - High prevalence setting: Treating 85% SAC + 40% adults for 15 years annually

Low adult burden: 90% simulations achieve elimination

High adult burden: 0% simulations achieve elimination

*SAC: 5-14 years of age
Conclusions

- **Low to moderate prevalence settings:**
  - SAC-only data is sufficient
  - 75% SAC-only treatment will likely reach the WHO goals within 5 years

- **High prevalence settings:**
  - SAC and adult data needed to inform optimal treatment strategy
  - Increase and expansion of treatment coverage to include adults is needed
  - Logistical challenges

*Toor J et al. (2018) Are we on our way to achieving the 2020 goals for schistosomiasis morbidity control using current WHO guidelines? *CID.*

*SAC: 5-14 years of age*
Future work

- Elimination (breaking of transmission)
- Diagnostics: Kato-Katz, CCA
- Impact of migration on results
- Extend results to *S. haematobium*
Acknowledgements

◆ James Truscott, Marleen Werkman, Anna Phillips, Roy Anderson
◆ Ramzi Alsallaq, David Gurarie, Charles King
◆ Graham Medley
◆ Hugo Turner
◆ Simon Brooker
◆ Deirdre Hollingsworth

More detailed M&E talk on Monday 29 Oct at 11:30am
10:15-12:00pm Session 17 –
Schistosomiasis - Trematodes: Epidemiology & Control
Extra slides…


<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Fecundity</td>
<td>0.34 eggs/female/sample</td>
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<tr>
<td>Egg distribution within the individual</td>
<td>0.87</td>
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<tr>
<td>Aggregation parameter</td>
<td>0.04 (baseline SAC prevalence settings close to 10%); 0.24 (baseline SAC prevalence settings &gt; 10%)</td>
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<tr>
<td>Density dependence fecundity</td>
<td>0.0007/female worm</td>
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<tr>
<td>Worm lifespan</td>
<td>5.7 years</td>
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<tr>
<td>Drug efficacy</td>
<td>86.3%</td>
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Low adult burden setting:
Age specific contact rates for 0-5, 5-10, 10-16, 16+ years of age | 0.01, 1.2, 1, 0.02 |

Moderate adult burden setting:
Age specific contact rates for 0-5, 5-10, 10-16, 16+ years of age | 0.032, 0.61, 1, 0.06 |

High adult burden setting:
Age specific contact rates for 0-5, 5-12, 12-20, 20+ years of age | 0.01, 0.61, 1, 0.12 |

Prevalence of infection: Percentage of population having egg count threshold (or eggs per gram, epg) > 0

Prevalence of heavy-intensity infections: Percentage of population having egg count threshold ≥ 16 (epg ≥ 400 divided by 24 to convert to egg count)

Human demography: Based on Uganda’s demographic profile

- Parameter values used within the age-structured deterministic model for *Schistosoma mansoni* (based on previous studies).