LONDON CENTRE FOR NEGLECTED TROPICAL DISEASE RESEARCH

MRC Centre for Global Infectious Disease Analysis

Imperial College London

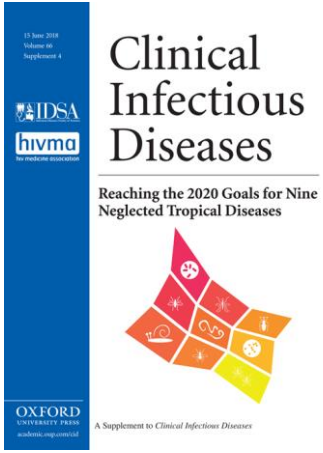
NTD MODELLING CONSORTIUM

Modelling insights into Schistosomiasis control and elimination

Jaspreet Toor, James Truscott, Marleen Werkman, Hugo Turner, Ramzi Alsallaq, David Gurarie, Charles King, Graham Medley, Deirdre Hollingsworth, Roy Anderson

NTD modelling consortium

- 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

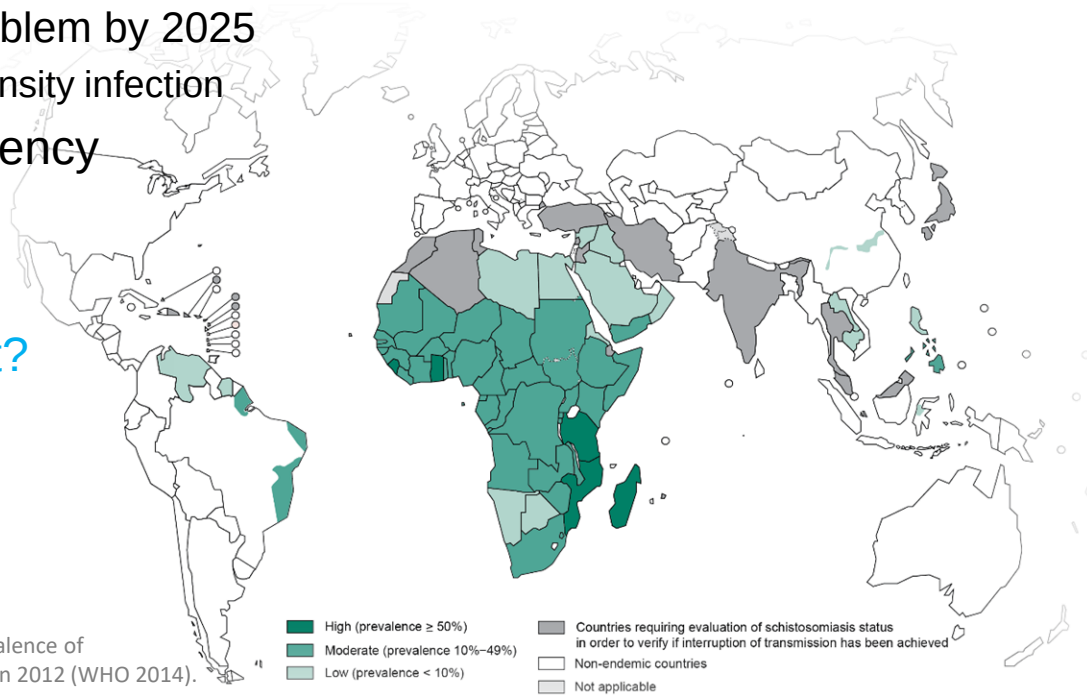
Overview

- 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

Photo credit to SCI

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?

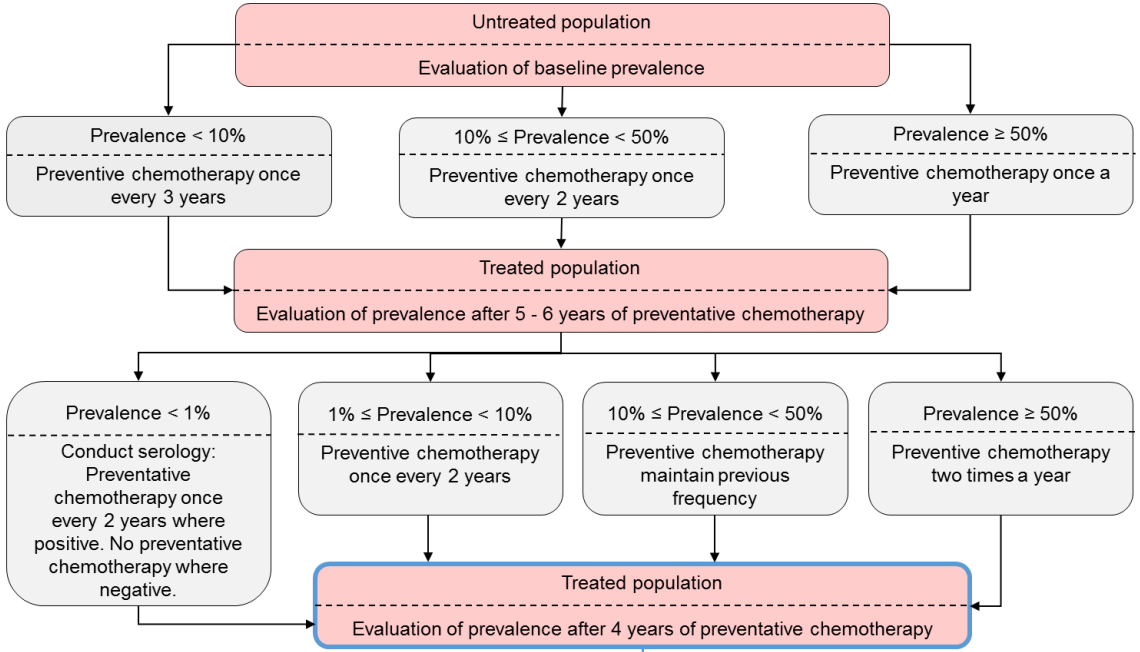


Worldwide prevalence of schistosomiasis in 2012 (WHO 2014).

*SAC: 5-14 years of age

Recommended adaptations

Current WHO guidelines (75% SAC coverage)



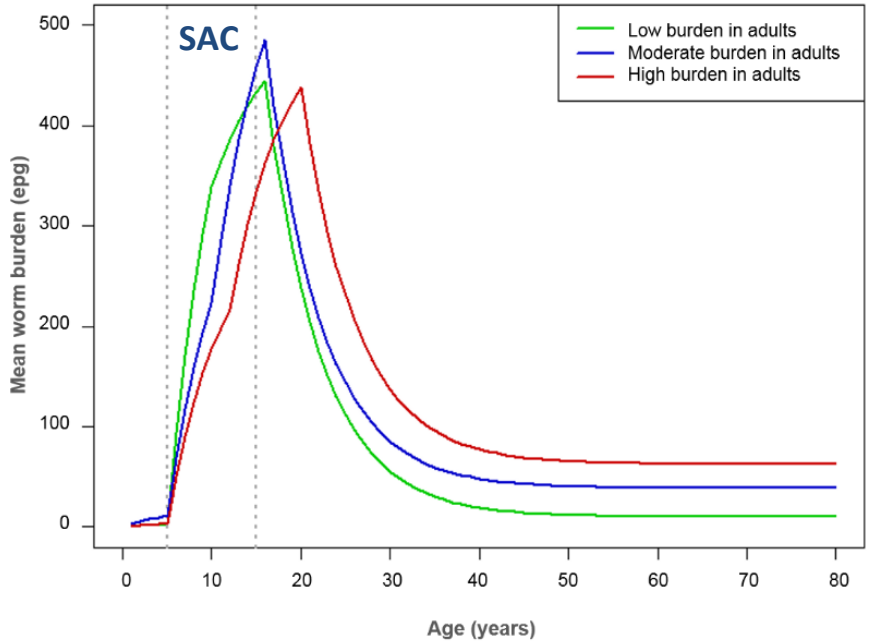
Recommended adaptations (for next 6 years)

*SAC: 5-14 years of age

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

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?



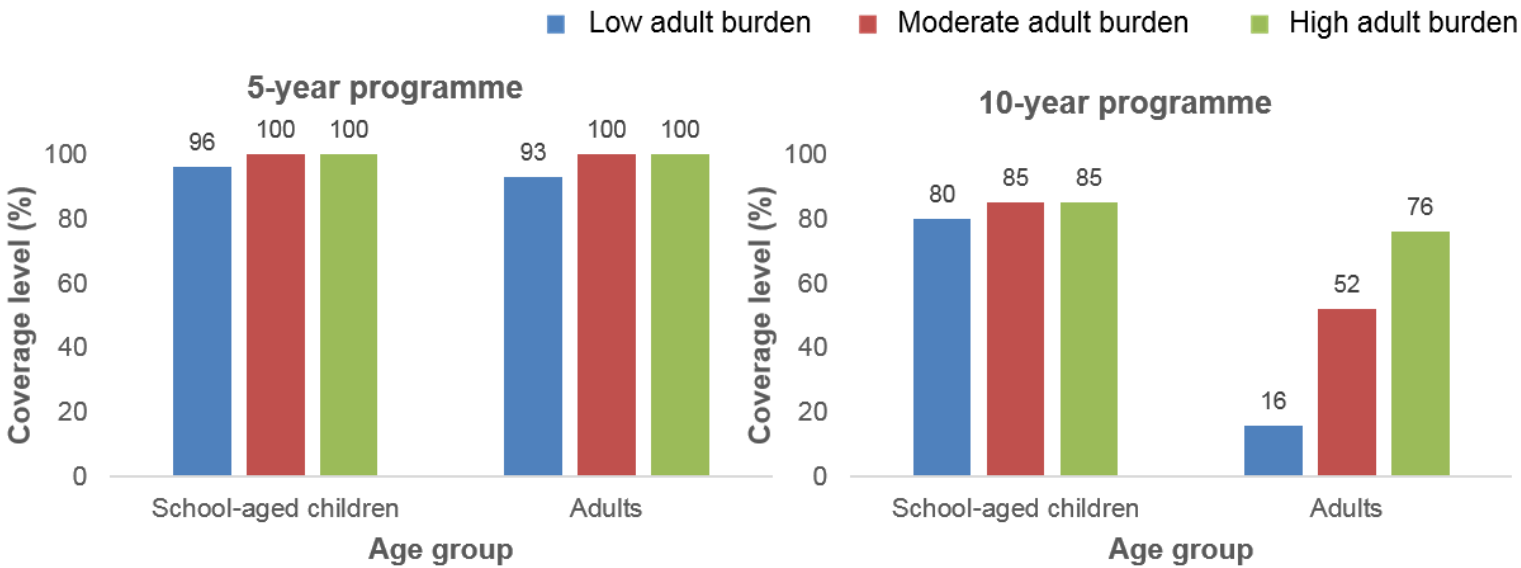
*SAC: 5-14 years of age

Toor J et al. (2018) The design of schistosomiasis monitoring and evaluation programmes: The importance of collecting adult data to inform treatment strategies for *Schistosoma mansoni. PLoS NTDs.*

Required coverage levels

High prevalence settings (≥50% SAC baseline prevalence)

WHO goal of elimination as a public health problem



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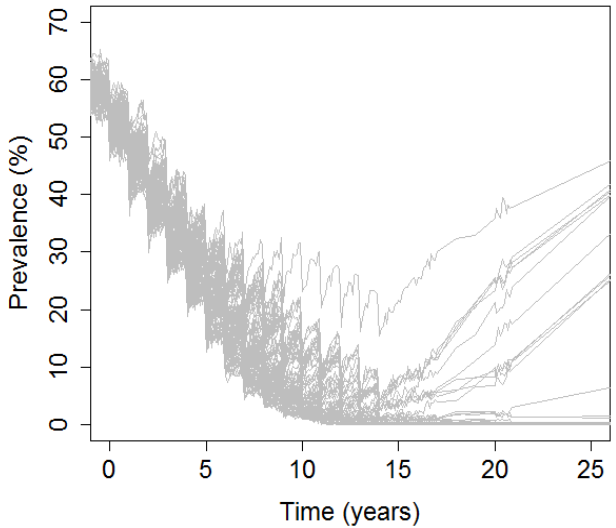
Toor J et al. (2018) The design of schistosomiasis monitoring and evaluation programmes: The importance of collecting adult data to inform treatment strategies for *Schistosoma mansoni. PLoS NTDs.*

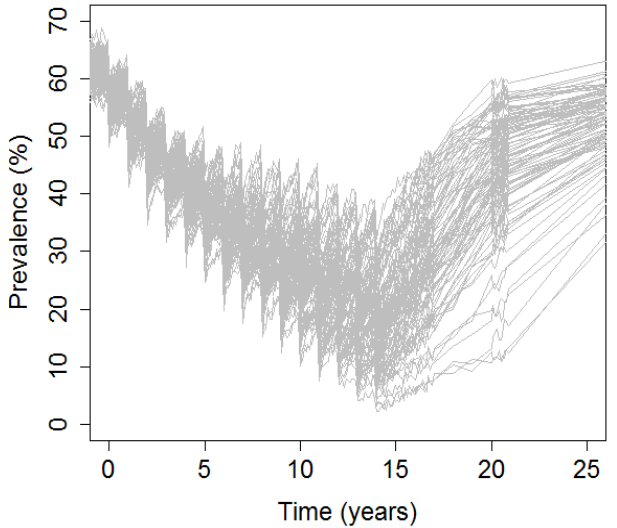
Moving towards elimination

- 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

*SAC: 5-14 years of age

Toor J et al. (2018) Are we on our way to achieving the 2020 goals for schistosomiasis morbidity control using current WHO guidelines? *CID*.
Toor J et al. (2018) The design of schistosomiasis monitoring and evaluation programmes: The importance of collecting adult data to inform treatment strategies for *Schistosoma mansoni*. *PLoS NTDs*.

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

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CIFF CHILDREN'S INVESTMENT FUND FOUNDATION

MRC Centre for Global Infectious Disease Analysis

Imperial College London

- Extra slides…

Recent publications

- Toor J, Turner HC, Truscott JE, Werkman M, Phillips AE, Alsallaq R, Medley GF, King CH and Anderson RM (2018) The design of schistosomiasis monitoring and evaluation programmes: The importance of collecting adult data to inform treatment strategies for *Schistosoma mansoni. PLoS NTDs.*
- Toor J, Alsallaq R, Truscott JE, Turner HC, Werkman M, Gurarie D, King CH and Anderson RM (2018) Are we on our way to achieving the 2020 goals for schistosomiasis morbidity control using current WHO guidelines? *Clinical Infectious Diseases*.
- Turner HC, Toor J, Hollingsworth TD and Anderson RM (2017) Economic evaluations of mass drug administration: The importance of economies of scale and scope. *Clinical Infectious Diseases*.
- Stylianou A, Hadjichrysanthou C, Truscott JE and Anderson RM (2017) Developing a mathematical model for the evaluation of the potential impact of a partially efficacious vaccine on the transmission dynamics of *Schistosoma mansoni* in human communities. *Parasites & Vectors*.
- Turner HC, Truscott JE, Bettis AA, Farrell SH, Deol A, Whitton JM, Fleming FM and Anderson RM (2017) Evaluating the variation in the projected benefit of community-wide mass treatment for schistosomiasis: Implications for future economic evaluations. *Parasites & Vectors*.
- Turner HC et al. (2017) Economic Considerations for Moving beyond the Kato-Katz Technique for Diagnosing Intestinal Parasites As We Move Towards Elimination. *Trends in Parasitology.*
- Truscott JE, Gurarie D, Alsallaq R, Toor J, Yoon N, Farrell SH, Turner HC, Phillips AE, Aurelio HO, Ferro J, King CH and Anderson RM (2017) A comparison of two mathematical models of the impact of mass drug administration on the transmission and control of schistosomiasis. *Epidemics*.
- Farrell S, Truscott JE and Anderson RM (*In press*) The importance of patient compliance in repeated rounds of drug treatment for elimination of intestinal helminths. *Parasites & Vectors*.
- Anderson RM, Turner HC, Farrell SH and Truscott JC (2016) Studies of the Transmission Dynamics, Mathematical Model Development and the Control of Schistosome Parasites by Mass Drug Administration in Human Communities. *Advances in Parasitology*.
- Shuford KV, Turner HC and Anderson RM (2016) Compliance with anthelmintic treatment in the neglected tropical diseases control programmes: a systematic review. *Parasites & Vectors*.
- Anderson RM, Turner HC, Farrell SH, Yang J and Truscott JE (2015) What is required in terms of mass drug administration to interrupt the transmission of schistosome infections in regions of endemic infection? *Parasites & Vectors*.
- Hollingsworth TD, Adams ER, Anderson RM, et al. (2015) Quantitative analyses and modelling to support achievement of the 2020 goals for nine neglected tropical diseases. *Parasites and Vectors*.

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

Parameter	Value
Fecundity	0.34 eggs/female/sample
Egg distribution within the individual	0.87
Aggregation parameter	0.04 (baseline SAC prevalence settings close to 10%); 0.24 (baseline SAC prevalence settings > 10%)
Density dependence fecundity	0.0007/female worm
Worm lifespan	5.7 years
Drug efficacy	86.3%
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