

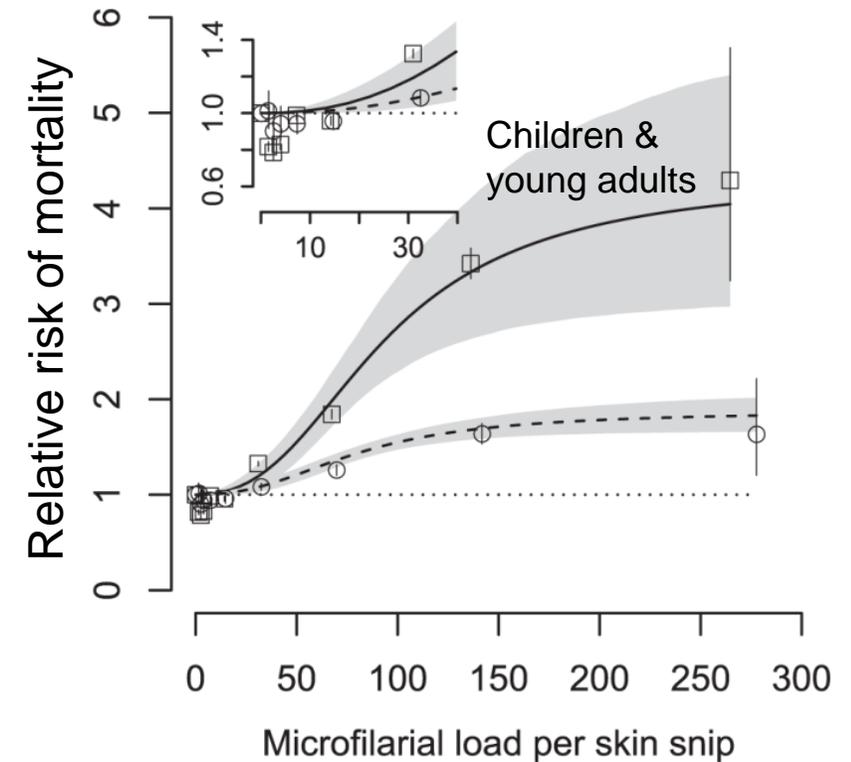
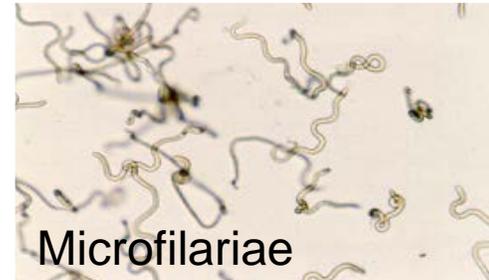
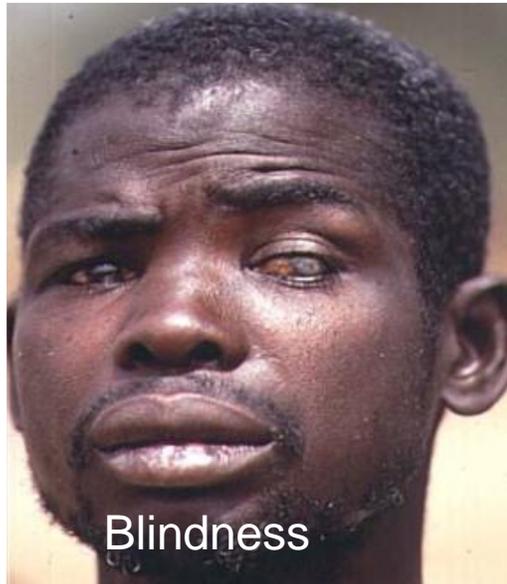


Modelling the elimination of river blindness using long-term epidemiological and programmatic data from Mali and Senegal

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London Centre for Neglected Tropical Disease Research
Mathematical Modelling for NTDs
Wednesday 26th April 2017

Infection, transmission, disease & mortality



The 2012 World Health Organization Roadmap & London Declaration

“THIS ROADMAP FOR IMPLEMENTATION REPRESENTS THE NEXT STEP FORWARD IN RELIEVING AND, IN MANY CASES, FINALLY ENDING THE VAST MISERY CAUSED BY THESE ANCIENT DISEASES OF POVERTY.”

Table 1a. Targets and milestones for elimination and eradication of neglected tropical diseases, 2015–2020*
At a glance

DISEASE	2015				2020			
	Eradication	Global elimination	Regional elimination	Country elimination	Eradication	Global elimination	Regional elimination	Country elimination
Rabies ^b			✓ Latin America				✓ South-East Asia and Western Pacific regions	
Blinding trachoma						✓		
Endemic treponematoses (yaws)					✓			
Leprosy						✓		
Chagas disease			✓ Transmission through blood transfusion interrupted				✓ Intra-domiciliary transmission interrupted in the Region of the Americas	
Human African trypanosomiasis				✓ In 80% of foci		✓		
Visceral leishmaniasis							✓ Indian subcontinent	
Dracunculiasis	✓							
Lymphatic filariasis						✓		
Onchocerciasis			✓ Latin America	✓ Yemen				✓ Selected countries in Africa
Schistosomiasis			✓ Eastern Mediterranean Region, Caribbean, Indonesia and the Mekong River basin				✓ Region of the Americas and Western Pacific Region	✓ Selected countries in Africa

The NTD Modelling Consortium

Are we on track to reach the WHO 2020 goals with current strategies?

(8 NTDs: **onchocerciasis**; leishmaniasis; leprosy; lymphatic filariasis; human Africa trypanosomiasis; schistosomiasis; soil-transmitted helminthiases; trachoma)



ONCHOSIM

- Stochastic worm-based small community model
- Age, sex and individual (host) variation in exposure
- Elimination explored by parasite extinction (including breakpoint effects plus 'stochastic fade-out') & operational prevalence thresholds

EPIONCHO

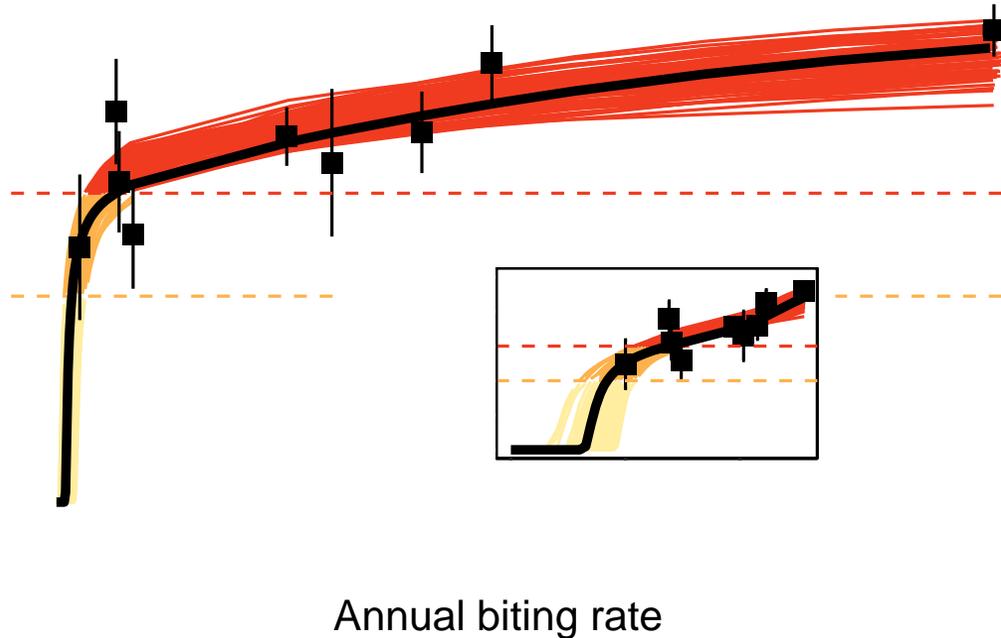
- Deterministic mean-based large population model
- Age and sex variation in exposure
- Elimination explored by parasite extinction (by population breakpoint) & operational prevalence thresholds

Comparison of prevalence & intensity dynamics plus times to elimination using annual or biannual mass treatment with ivermectin

Relationship between blackfly biting rate (transmission intensity) & microfilarial prevalence

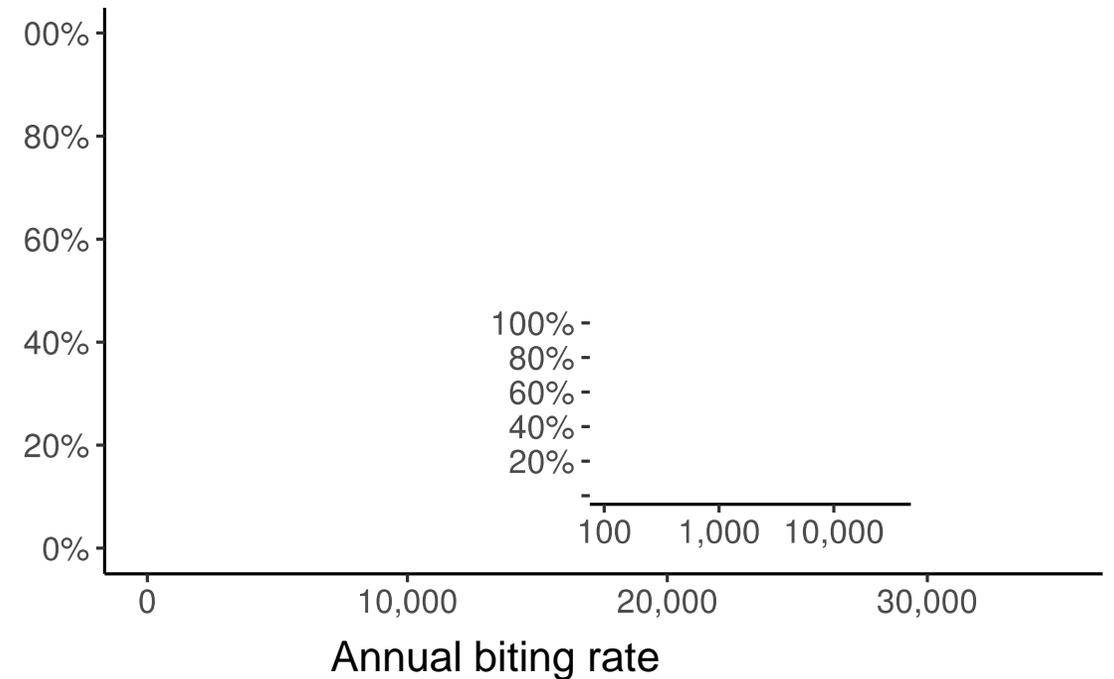
EPIONCHO

Microfilarial prevalence



ONCHOSIM

Microfilarial prevalence



Elimination in Mali & Senegal

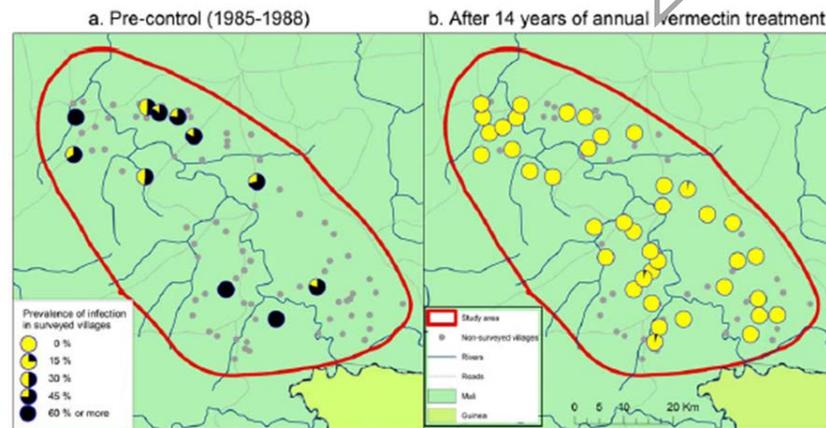
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PLoS NEGLECTED TROPICAL DISEASES

Feasibility of Onchocerciasis Elimination with Ivermectin Treatment in Endemic Foci in Africa: First Evidence from Studies in Mali and Senegal

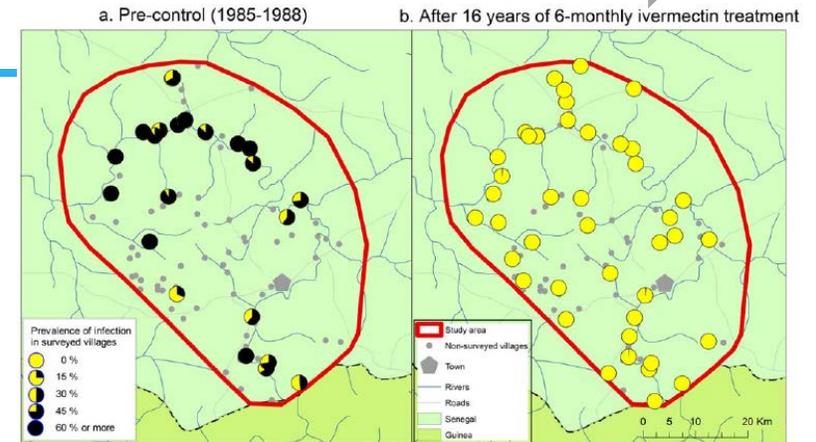
Lamine Diawara¹, Mamadou O. Traoré², Alioune Badji¹, Yiriba Bissan³, Konimba Doumbia², Soula F. Goita², Lassana Konaté⁴, Kalifa Mounkoro², Moussa D. Sarr¹, Amadou F. Seck¹, Laurent Toé³, Seyni Tourée¹, Jan H. F. Remme^{5*}

15 years aCDTI



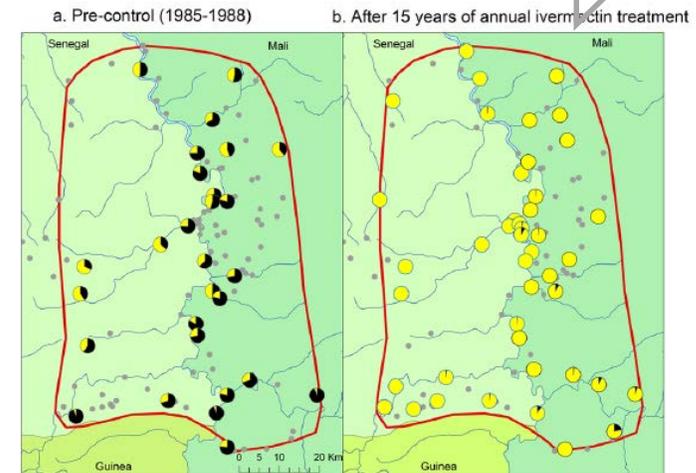
R. Bakoye focus, Mali

17 years bCDTI



R. Gambia focus, Senegal

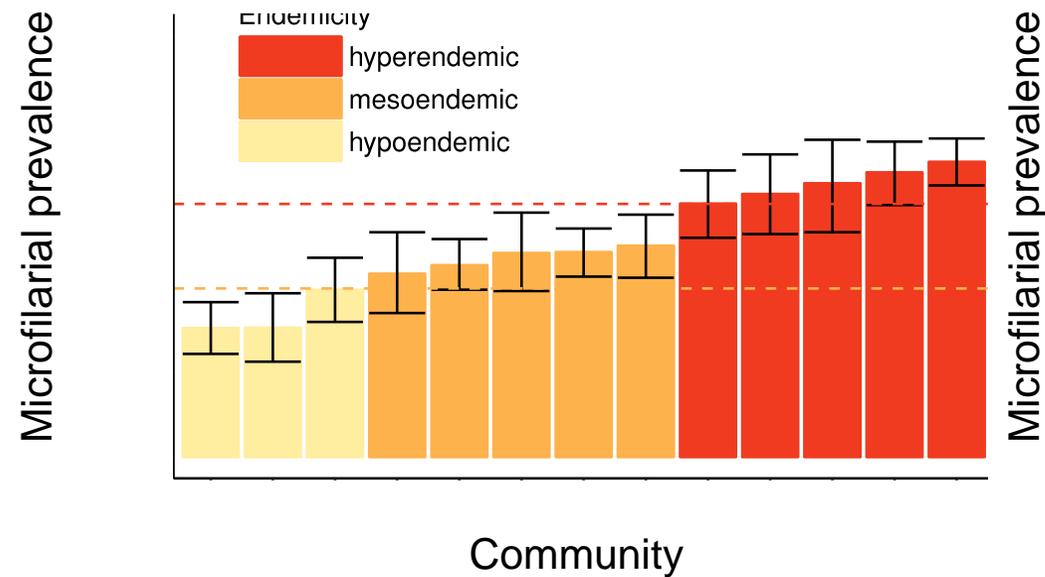
16 years aCDTI



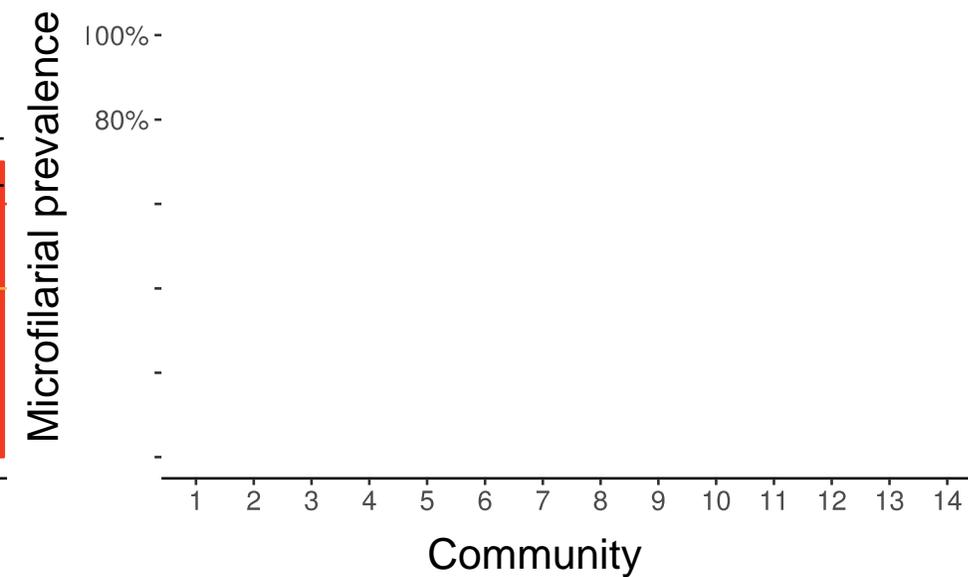
R. Falame focus, Mali/Senegal

Pre-intervention (baseline) microfilarial prevalence in 27 communities

River Bakoye, Mali



River Gambia, Senegal



Longitudinal validation & projection to 2020

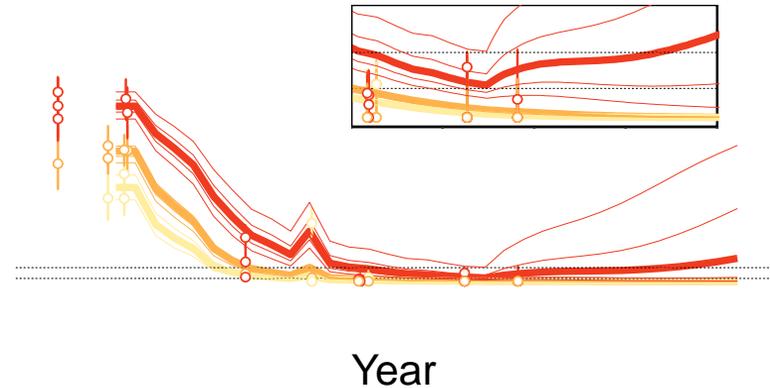
EPIONCHO

ONCHOSIM

River Bakoye,
Mali
(annual treatment)

River Gambia,
Senegal
(biannual treatment)

Microfilarial prevalence



Year

Year

Year

EPIONCHO elimination or recrudescence?

River Bakoye, Mali

Coverage	9/13 (69%)	12/13 (92%)	13/13 (100%)	13/13 (100%)	Coverage
	9/13 (69%)	12/13 (92%)	13/13 (100%)	13/13 (100%)	
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More training data



River Gambia, Senegal

More training data

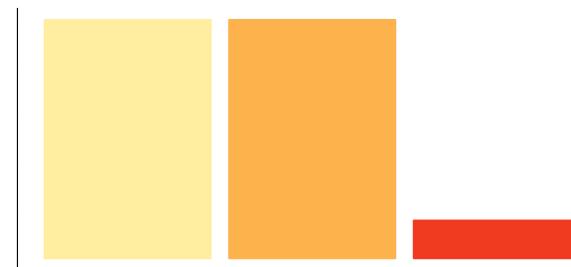


Communities with projection of sustained elimination by focus

Probability of elimination driven by estimated pre-intervention endemicity (& vector biting rate)

% communities with elimination projection

River Bakoye, Mali



Increasing endemicity



River Gambia, Senegal

Increasing endemicity



Conclusions

- Feasibility of elimination by 2020 or 2025 depends on start year of intervention; intensity of transmission, the frequency & coverage of treatment with ivermectin
 - Elimination may not be feasible in highly endemic transmission settings (high vector biting rate) using ivermectin alone
 - Where elimination is unlikely, alternative treatment strategies should be considered
 - vector control
 - test & treat with anti-wolbachial macrofilaricides
 - new potential MDA drugs like moxidectin
 - Post-treatment surveillance must be very sensitive to detect low-level (latent) infections & undertaken for at least 3-5 years
 - Model outputs should be aligned to new serological and entomological indicators that define latest elimination thresholds & PTS protocols
-



Acknowledgments

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Dr Sake de Vlas



Dr Mamadou Traoré



Dr Christian Bottomley



Dr Hans Remme



BILL & MELINDA
GATES foundation