HAT MEPP Newsletter

Issue 2 (Aug 2022 – December 2023)

NEWS IN BRIEF

As we embark upon the final stretch of HAT MEPP 2 we have been taking stock of the team's remarkable journey thus far. From enhancing the previous gHAT modelling for regions in the DRC, Côte d'Ivoire, Guinea, Uganda, and Chad, to fine-tuning predictions at smaller spatial scales. These significant technical strides forward will ensure that our future policy recommendations align closely with the practical capacities of teams on the ground, enhancing operational effectiveness.

HIGHLIGHTED PUBLICATION

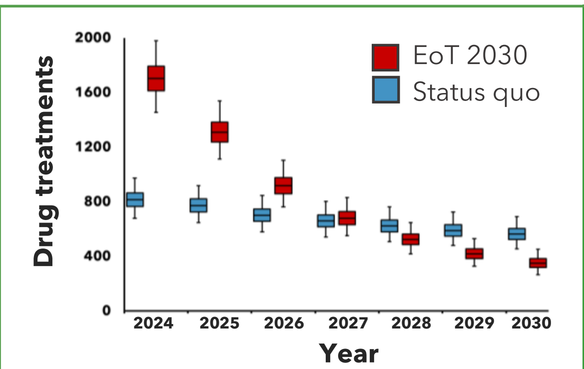
In an article published jointly with the Côte d'Ivoire sleeping sickness programme (PNETHA) and their partners, we delved into the intervention efforts behind the successful elimination of gHAT as a public health problem in Côte d'Ivoire in 2020 and the ongoing progress towards elimination of transmission. Building on this success, Minayegninrin Koné (PNETHA) and Sam (HAT MEPP) are now teaming up for a cost-effective analysis tailored for Côte d'Ivoire, planned for completion in 2024.

VISITING COLLABORATORS

September 2022 included a visit to Côte d'Ivoire, refining our model and gathering input on future strategies. We joined the DRC National HAT Day in 2023, celebrating strides made by PNLTHA-DRC & partners against the disease. After a five-year break from the in-person format, our team were pleased to return to the WHO Stakeholders Meeting in Geneva in June 2023 to update programme directors and partners on our latest modelling results. The team were also in Guinea in November visiting PNLTHA, discussing current model refinements and future elimination plans.

WORK IN THE PIPELINE

In collaboration with the Ugandan sleeping sickness programme and partners, Ching-I is finalising the gHAT model for Uganda, including exploring when we expect to observe the final reported case. The HAT MEPP team are extending their analysis in Chad to include all foci and looks forward to meeting PNLTHA-Chad in 2024 to discuss this analysis in person. Excitingly, model refinements enabling fitting at smaller spatial scales will soon extend to more health areas in the DRC – stay tuned for updates!



EXPLORE THE WHOLE DRC ANALYSIS

Work has continued at pace, integrating the many outputs generated by the models into our user-friendly platform created by Paul, our software developer. Marina's cost-effectiveness results for the whole of the DRC are now ready to explore, with new functionality including forecasting for numbers of treatments, diagnostics and Tiny Targets.

Dr Paul Brown , HAT MEPP Software Developer

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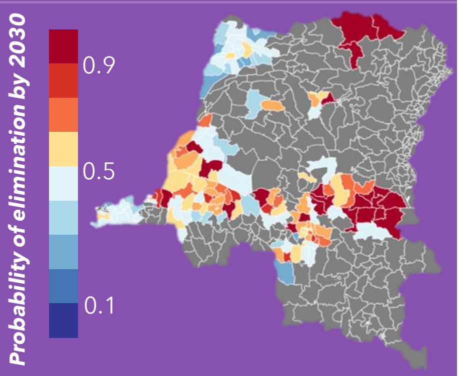
Dr Marina Antillon
HAT MEPP Health Economist

COST OF ELIMINATION FOR THE DRC

Under the current trajectory, only a third of health zones in the DRC, are set to eliminate transmission by 2030. Marina's latest article, which expands on her five-health-zone cost-effectiveness analysis, focuses on strategies to achieve nationwide elimination.

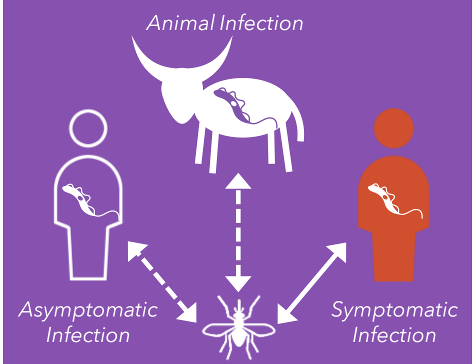


Insights from this analysis indicate that around 30% of health zones, especially those in Kasai Occidental and Maniema-Katanga, may fail to achieve a 90% probability of eliminating transmission despite strategy changes, although these changes do increase the elimination likelihood Skip to page 3 for more insights.

Dr Ron Crump
HAT MEPP Modeller

CRYPTIC INFECTIONS & ELIMINATION

Hidden *T.b. gambiense* infections have been found in humans and animals but the role of these in the transmission cycle remains largely uncertain. In this study, Ron has employed a statistical approach to gauge the significance of cryptic infections in transmission dynamics.

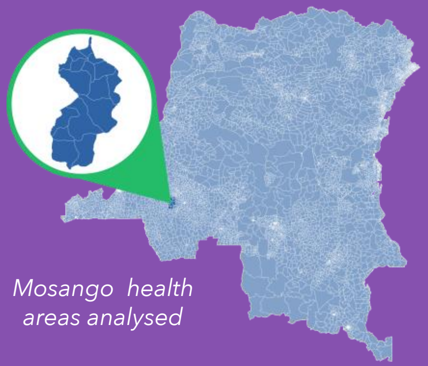


By examining the statistical evidence for models with and without asymptomatic human or animal infections, his research sheds light on what this means for elimination predictions and the impact of interventions such as screen and treat or vector control. Click to explore Ron's research.

Dr Chris Davies
HAT MEPP Modeller

FROM HEALTH AREAS TO HEALTH ZONES

With small pockets of infection remaining, the value of modelling at a smaller spatial scale is clear, particularly for targeting and prioritising field activities. Work on fitting the model to data from 16 health areas in Mosango (DRC) has now been completed by Chris.



Summing the health area results closely matches previous health-zone-level fits, with the small-scale approach better at capturing uncertainty and highlighting infection hotspots. This will now be followed by expansion to the remaining ~1200 analysable health areas across the DRC. Read more here.

OTHER NEWS

- Chris Davis, who adapted the model for fitting at smaller spatial scales as featured in this issue of the Newsletter, has now moved on from the HAT MEPP team. Ron Crump will be continuing his fantastic work by expanding the fitting of data to health areas outside of the Mosango health zone.
- Marina Antillon, who has been in the team since 2018 and has conducted many of our health economic analyses, will also be leaving the team. Marina and Chris will be very much missed!
- We are pleased to welcome the temporary team member Brady Hooley, from Swiss TPH, who has been conducting the Uganda cost-effectiveness analysis, which we anticipate will be completed soon.

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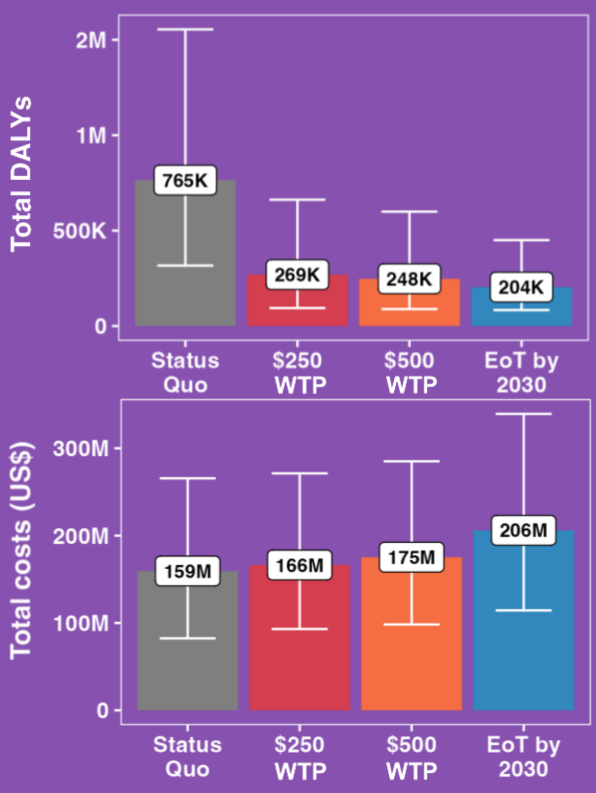
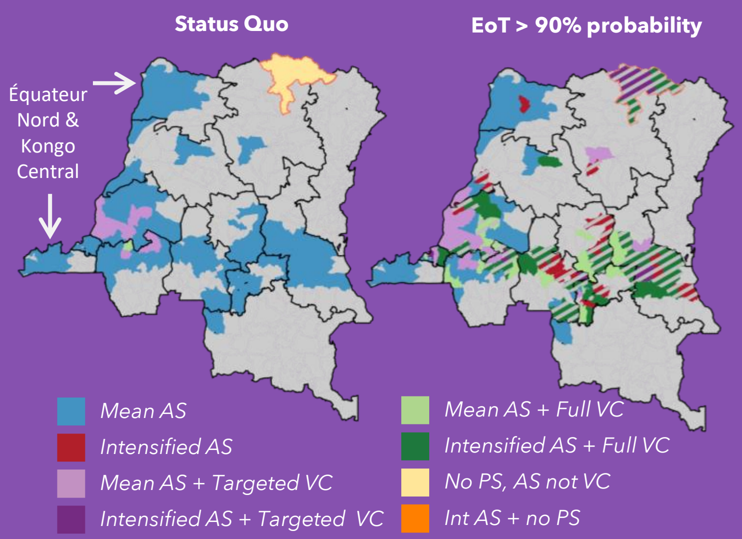
COST OF ELIMINATION FOR THE DRC

In collaboration with the DRC sleeping sickness control program and their partners, Marina's study evaluated several potential intervention strategies at the health-zone level, focusing on cost-effectiveness in terms of disease burden (DALYs) and enhancing the likelihood of eliminating transmission (EoT) by 2030.

Her latest findings indicate that Kongo Central and Équateur Nord coordinations have a promising outlook under current (***Status Quo***) strategies with others requiring adjustments to optimise outcomes. A total of 95 health zones are highlighted as requiring a shift in strategy to boost the likelihood of EoT by 2030. Among these, 48 face the additional challenge that even the strategy maximising EoT falls short of a 90% probability by 2030 as indicated by hatched health zones in the map opposite.



Total DALYs and costs for the whole DRC (2024-2040) at different economic and elimination objectives.
WTP = Willingness to pay



Optimal strategies given current levels of investment (***Status quo***) or to achieve EoT by 2030 with higher than 90% probability (***EoT > 90% probability***)

Based on existing strategies (***Status Quo***), 117 out of 166 health zones are on track to achieve EoT by 2030. This endeavour comes with a projected cost of $159M and an accumulation of an estimated 765K DALYs over a 16-year time horizon (grey bars in graph opposite).

Introducing new interventions aimed at reaching ***EoT with >90% probability***, we anticipate that 21 more health zones could reach EoT requiring only $47M of additional investment (grey vs blue bars). This move could prevent 561K DALYs. Despite this being a relatively small investment, it's crucial to highlight that nearly one-fifth of this ($9M) would be required in the first year of switching strategies and would require a huge operational undertaking.

Explore the cost-effectiveness results further here

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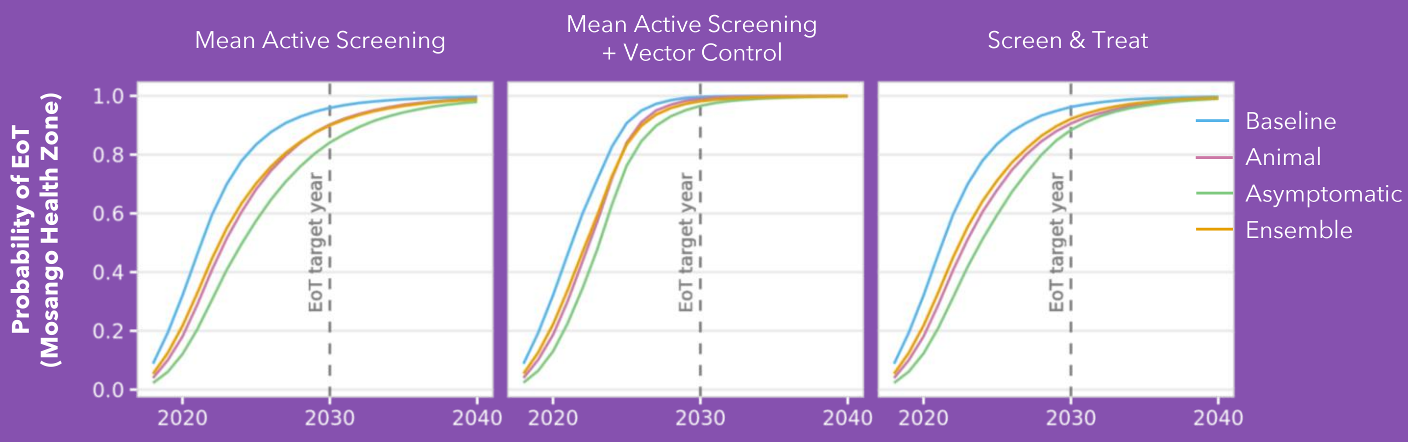
WILL CRYPTIC INFECTIONS IMPACT THE ELIMINATION GOAL?

Conducted across five health zones in the DRC and spanning a broad range of prevalences, Ron's analysis delves into the much-debated topic of cryptic infections and their potential impact on elimination of transmission (EoT). Building on the ***baseline Warwick gHAT*** model (blue line below) two additional model variants were added: the ***animal transmission model*** – allowing for the potential role of animals as carriers and transmitters of infection (red line below) - and the ***asymptomatic transmission model*** – allowing for the presence of asymptomatic human infections, their detectability in blood tests, and their capacity to self-cure without intervention (green line below). Calibrating these model variants to data from in each health zone, it is possible to infer which has the greatest statistical support. This ***ensemble*** of model variants (orange line below) was used to assess the probability of EoT across the health zones under specific strategies.



Comparing the probabilities of eliminating transmission (EoT) over time according to the baseline, animal, asymptomatic and ensemble model variants under three strategies

As anticipated, the ***baseline*** model is the most optimistic regarding the probability of achieving EoT. Furthermore, simulations under a Screen & Treat strategy highlight the potential benefit of reducing transmission by removing the parasitological confirmation step before treatment, particularly in the asymptomatic model variant. The results also highlight the advantages of vector control measures specifically in the presence of cryptic infections. However, whilst vector control is a valuable tool, the implementation of such a resource-intensive intervention necessitates careful prioritisation.

This analysis indicates we can be cautiously optimistic and, despite emerging evidence of trypanosomes in the skin without detectable blood parasites, their contribution to transmission dynamics appears limited in the DRC. Nevertheless, we acknowledge the potential for asymptomatic transmission, albeit with a relatively minor impact on our elimination targets.

As we continue to refine our understanding of gHAT transmission dynamics, these insights will serve as invaluable guides for developing targeted interventions. Together, let us remain steadfast in our commitment to eliminating this formidable disease.

Explore the cryptic reservoir results further here!

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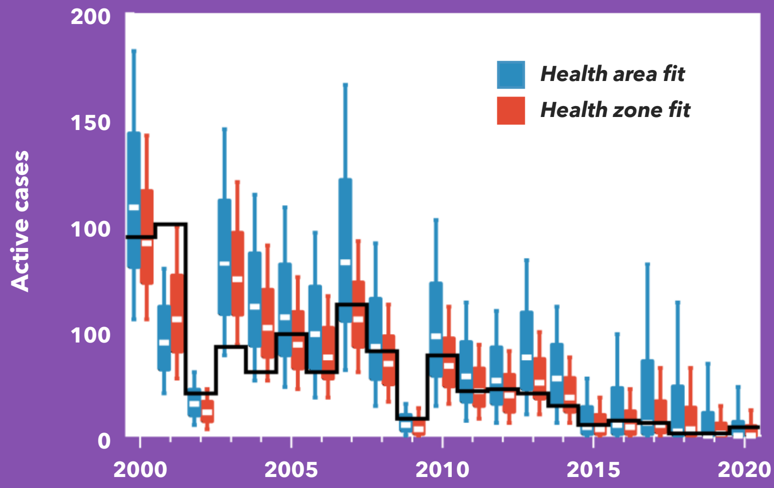
FROM HEALTH ZONES TO HEALTH AREAS

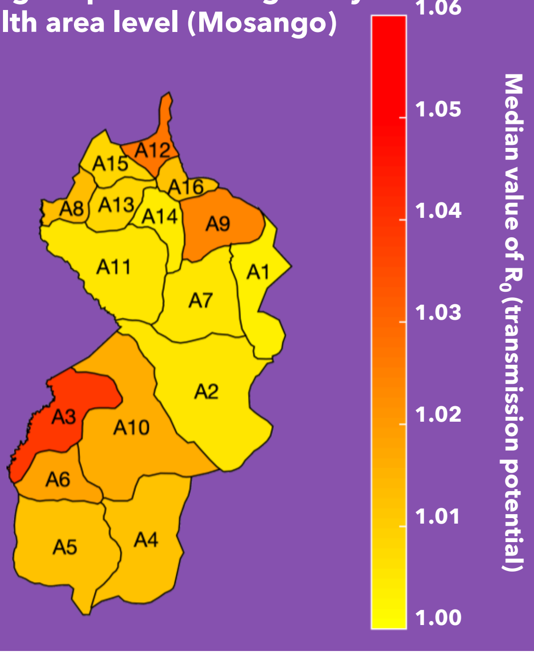
Despite the intensification of gHAT interventions leading to a decline in case numbers in the last twenty years, new challenges have now emerged that include locating infection hotspots and where and how to focus future elimination efforts. As the HAT MEPP team continue to support on-the-ground activities, and as cases continue towards zero, so the model needs to capture the heterogeneity of gHAT prevalence at smaller spatial scales. However, data at smaller spatial scales is often limited and noisy which makes this modelling task particularly challenging. In the DRC, these smaller "health areas" contain approximately 10,000 people versus 150,000 per "health zone" meaning there are many more regions to now analyse.

In our present study we focus on health areas in the health zone of Mosango (DRC). Our gHAT model was fit to data from Mosango's 16 health areas and aggregation of the results corresponded well with previous health zone level fits (*right*; blue represents aggregated health area fits, red represents the health zone fit, the black line represents real case data). This means health zone fits appear to be capturing the overall dynamics well, but fitting at the health area level allows us to zoom into the smaller scale and better capture chance events in small populations or at very low infection level.

Model fits to active case reporting



Modelling of spatial heterogeneity at health area level (Mosango)



This modelling can also indicate in which health areas most transmission of gHAT is happening (*left*: red represents higher transmission potential (R_0)). Health area modelling will therefore enable the simulation of localised intervention strategies which were not possible at larger spatial scales. Although roll-out to other analysable health areas is now necessary, using smaller spatial scales to reflect the real-world situation in the models will improve recommendations of how and where to focus efforts and interventions to achieve the elimination of gHAT transmission.

Delve into Chris' health area analysis here!

THE HAT MEPP TEAM

Prof Kat Rock
Team Leader and Modeller
"A mathematician by training, I guide our team from big research questions through to technical implementation and dissemination"

Dr Ron Crump
Modeller
"My primary focus is on fitting gHAT models to historical case data and understanding epidemiological drivers of transmission"

Dr Ching-I Huang
Modeller
"I customise the model to capture location-specific historical interventions and tailor future strategies based the national programme and partners plans"

Dr Christopher Davis
Modeller
"I develop gHAT models at different spatial scales, from villages to larger regions, with a focus on stochastic modelling"

Prof Simon Spencer
Statistician
"I specialise in fitting transmission models for infectious diseases to data, especially for neglected tropical diseases"

Dr Louise Dyson
Modeller
"My primary focus on the HAT MEPP project is developing methods to monitor gHAT elimination progress and robustness of local elimination"

Prof Matt Keeling
Modeller
"I support methodological modelling aspects of the project, using my experience analysing many other infections of humans and animals"

Dr Emily Crowley
Scientific Project Manager
"I manage many of the external and internal components of the project as well as taking charge of the group's dissemination activities"

Dr Paul Brown
Software Developer
"My role involves the development of a user-friendly interface allowing users to explore visually the results of our simulations in detail"

Dr Marina Antillon
Health Economist
"I specialise in decision analysis, which considers optimal allocation of resources in the face of scarce resources"

Samuel Sutherland
Health Economist
"My role involves projection of resource use and health burden to enable comparison of alternative interventions"

Dr Brady Hooley
Health Economist
"I am a recently graduated postdoc who is supporting the cost-effectiveness analysis of gHAT elimination strategies in Uganda"

Prof Fabrizio Tediosi
Health Economist
"I specialise in economic evaluations in the context of elimination, drawing on my experiences from other NTDs and LMIC health systems"

Prof Jason Madan
Health Economist
"I provide guidance on health economic methods, drawing on my research interests in Global Health Economics and Health Economic Modelling"

WARWICK Swiss TPH

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