Quantifying transmission dynamics of HAT in a peri-elimination era through mathematical modelling

Kat Rock, Ching-I Huang and Marina Antillon
University of Warwick and Swiss TPH
On behalf of HAT modelling/economics groups in NTD Modelling Consortium and HAT MEPP
Predictive modelling

**Prediction across scales:** Province, health-zone, health-area, village

**Fully integrated approach:**
- Epidemiology & ecology
- Diagnostics & treatment
- Inference & prediction
- Economics & policy advice

5th HAT Platform Meeting, Kampala, 3rd-4th October 2018
Modelling strategy impact

What impact do the following strategies have on transmission of infection?

- Standard medical interventions: active and passive screening
- Vector control
- *Intensified/targeted active screening (such as a door-to-door strategy)
- *Enhanced passive surveillance (improving access to diagnostics)

*Current these interventions have been simulated but not matched to data

(Rock et al, CID, 2018)
## Modelling strategy impact

### Considered strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Baseline</th>
<th>Vector control</th>
<th>Enhanced passive surveillance</th>
<th>Targeted active screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic passive detection rate</td>
<td>Y</td>
<td>Y</td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td>Passive detection rate doubled</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>30% active screening</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>60% active screening (with equal coverage of low- and high-risk people)</td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td>Tiny targets with 60% tsetse reduction after one year</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>

### Incidence

- “High-risk” setting = 50-60 new infections per 10,000 (in 2017)
- “Low-risk” setting = 0.5-0.6 new infection per 10,000 (in 2017)

(Rock *et al*, CID, 2018)
All complimentary strategies are an improvement

Vector control is quick to impact new infection

(Rock et al, CID, 2018)
Results: New infections averted

Vector control averts most new infections

Medical strategies reduce human infection pool, but take longer to impact transmission

Elimination by 2030 seems very likely with VC, or in low-risk settings

(Rock et al, CID, 2018)
Results: cost framework

- We want to compare strategies in a fair way:
  - The vector control strategy costs more than the baseline strategy, but averts for new infections
  - The three complementary strategies cost different amounts
  - Other factors are important: preventing disease and death is our priority

- We use the mathematical modelling results in combination with intervention costs and disability adjusted life years (DALYs) to compare strategies
Results: probability cost effective

Willingness-to-pay per DALY averted

Assumptions:
- Time horizon: 2018-2030, discounting: 3%
- Switch to fexinidazole
- All interventions continue until 2030

---

5th HAT Platform Meeting, Kampala, 3rd-4th October 2018
Results: probability cost effective

Willingness-to-pay per DALY averted

High-risk
- Enhanced passive appears more cost-effective

Low-risk
- The baseline strategy has similar probability of being cost-effective as enhanced passive for low WTP
Results: cost breakdown

- Total (undiscounted) costs from 2018-2030
- Population size: 10,000
Conclusions

- Passive surveillance is most cost-effective in some settings because it averts more DALYs.
- But the enhanced passive surveillance strategy may not reach the 2030 elimination goal.
- Vector control can help reduce transmission quickly.

- **Combinations of strategies** could be more cost effective than individual complementary strategies.
Next steps: graphical user interface

- This study demonstrates the type of infection dynamics in a generic high- or low-risk setting
- Future work is needed to fit to regional data, and to include local costs and strategies
- HAT MEPP will work with national programmes and other researchers to provide these outputs

http://nero.wsbc.warwick.ac.uk/hatmepp/

Username: hatplatform
Password: meeting2018
http://nero.wsbc.warwick.ac.uk/hatmepp/
Username: hatplatform
Password: meeting2018
http://nero.wsbc.warwick.ac.uk/hatmepp/
Username: hatplatform
Password: meeting2018

5th HAT Platform Meeting, Kampala, 3rd-4th October 2018
http://nero.wsbc.warwick.ac.uk/hatmepp/

Username: hatplatform
Password: meeting2018
http://nero.wsbc.warwick.ac.uk/hatmepp/

Username: hatplatform
Password: meeting2018
Acknowledgements

Collaborators and data:

PNLTHA of Chad

Contact: Kat Rock
k.s.rock@warwick.ac.uk
www.go.warwick.ac.uk/hatmepp

Funding: BMGF