Summary

Measuring elimination of *gambiense* human African trypanosomiasis: A comparison of deceptively different metrics

Samuel A. Sutherland, Jason Madan, Kat S Rock

Modelling can offer insights into hidden metrics like true prevalence and infection timing. However, policy decisions must rely on observable data to ensure verifiability. The WHO aims to eliminate transmission of gHAT to humans by 2030, defining country-level success as five years with no new reported locally transmitted cases and adequate surveillance. While practical, as it is based on observable case reporting, this definition doesn't always align with more literal definitions of elimination, leading to potential discrepancies. Figure 1 shows a few hypothetical (not modelled) scenarios under different levels of prevalence and control showing how the different metrics may be met at different times in different circumstances. Example 1 shows a hypothetical scenario with good surveillance and control, whereas Example 2 shows a scenario with weak control and surveillance. You can see how weaker surveillance may make 5 years of no new reported cases occur before the last transmission event (LTE), highlighting the importance of the surveillance component of the WHO criteria for verification of EoT.

Our previous modelling has often predicted the time until EoT, using a literal interpretation of one year after the LTE. The recent publication of the WHO EoT indicator now allows us to compare differences between these elimination metrics which can be exacerbated by the slow progression of gHAT. In general we found that we would expect the WHO EoT indicator to be met around 7 years after the LTE if there is good active and passive screening, and this could be around 10 years if transmission was interrupted by adding vector control; this means it is highly likely that the LTE event has already occurred once the WHO indicator is verified. Figure 2 shows some example simulations based on existing model parameterisations from previous modelling work, but in a hypothetical setting with a fixed population of 100 000 people. In particular, the histograms at the bottom show the delay between the last transmission event and five years of no cases (for the WHO EoT indicator). In all the settings with good passive surveillance, the WHO indicator is almost certain to come after the LTE.

Models can also estimate when there is no infection remaining – the point at which there are no remaining infected hosts or vectors in the community.

Care should be taken when interpreting modelling results to avoid mix-ups between modelled estimates for EoT and the WHO EoT indicator. The HAT MEPP team will report on both metrics in future work to improve clarity for stakeholders. In the future the HAT Modelling and Economic Predictions for Policy (HAT MEPP) group will transition to reporting the Modelled-FTE and Modelled-WHO-EoT to make the distinction more clear between predictions for the transmission events and case reporting.

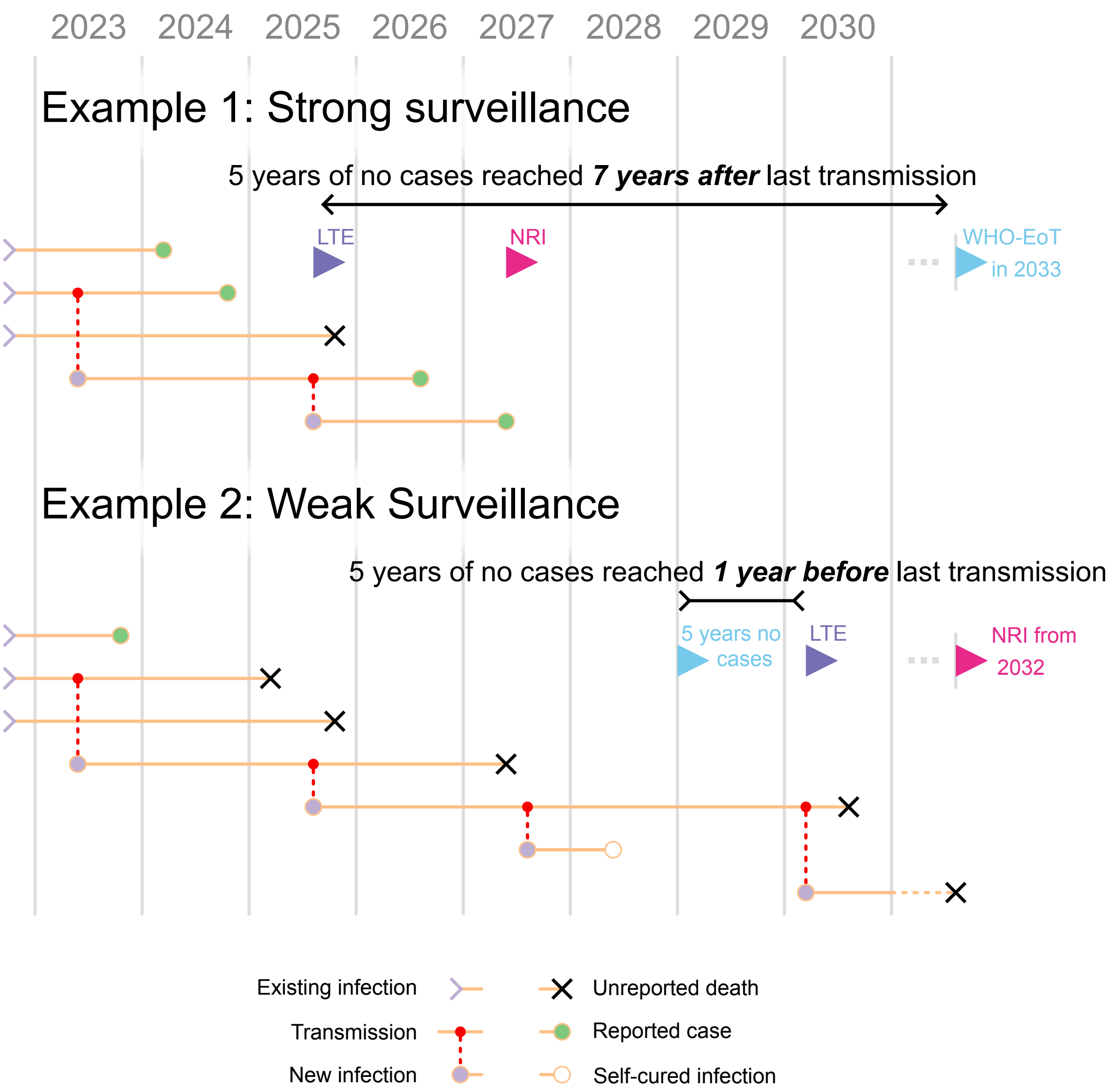

Figure 1: Two illustrations of possible pathways to country-level elimination starting from very low prevalence of gHAT infection. Both examples start with three extant infections in 2022 and the corresponding horizontal orange lines show individuals continuing to be infectious. We assume that infection ends in either detection (marked by green circles), an unreported death, (marked by black crosses), or a potential self-curing infection which are not reported (marked by an unfilled circle). Coloured flags mark the achievement of the three different elimination metrics: five years of no cases/WHO-EoT (blue), last transmission event (LTE, purple), and no remaining infection (NRI, pink). Note that in the second example we refer to "5 years no cases" instead of WHO-EoT because it is unlikely that such a setting would meet the criteria for the WHO metric of EoT due to insufficient surveillance.

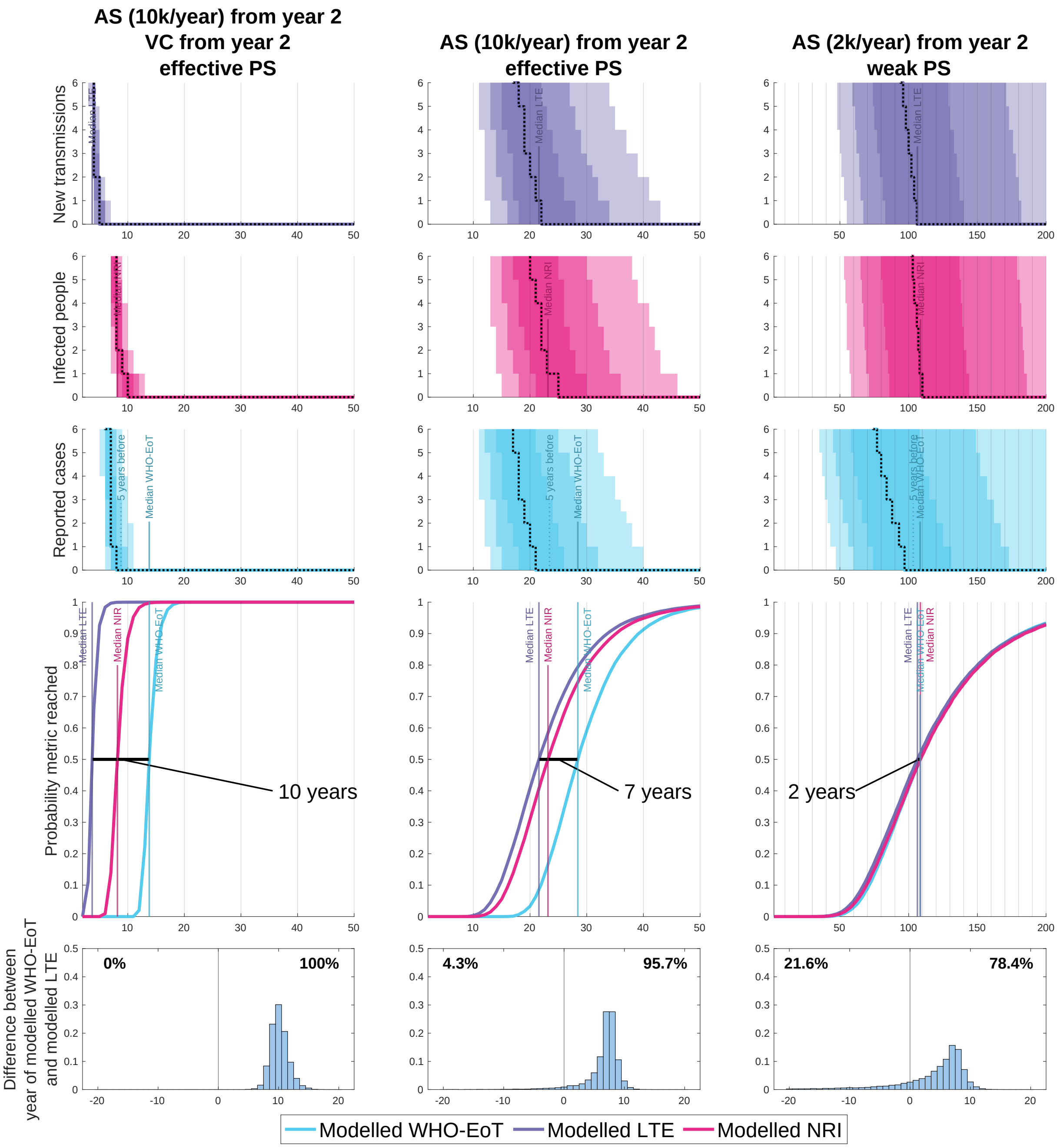

Figure 2: Model simulations showing various outputs and how they link to three different elimination metrics. The top three figures show the number of new infections (purple) and the number of cases each year (blue), as well as the number of infections remaining at any given time (pink). The solid lines show the median model output, with 50%, 80%, and 95% prediction intervals shown by the shaded regions. The fourth figure shows estimates of the probability of Modelled-WHO-EoT, Modelled-LTE (last transmission event) and Modelled-NRI (no remaining infections) by year, which are computed from the proportion of the 20,000 stochastic model simulations which have achieved the specific metric. The bottom figure shows a histogram of the delay between Modelled-LTE and WHO-EoT. The parameters used to generate the simulations used in this figure were based on our model parameterisation for Bagata health zone in Bandundu Nord coordination in the Democratic Republic of the Congo (DRC), although since we have not directly used case trends or intervention history here, this analysis does not reflect progress or predictions for the real health zone.