Predicting the impact of COVID-19 interruptions

Summary: Predicting the impact of COVID-19 interruptions on transmission of gambiense human African trypanosomiasis in two health zones of the Democratic Republic of Congo

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Objective
In addition to the direct consequences of the COVID-19 pandemic, COVID-19 impacts our ability to control other infectious diseases. In this study, we explore how interruption in control activities of gambiense human African trypanosomiasis (gHAT), such as screening, might influence the disease dynamics and related the goal of elimination of transmission (EOT) by 2030. We focus on two different health zones within Bandundu province, Bagata and Mosango, both classified as moderate-risk for gHAT transmission in 2016.

Methods
To study the impacts of interruptions of active screening for gHAT we use two stochastic models of gHAT infection, named Model S and Model W, developed independently and previously described in other modelling studies. These models take into account different stages of the disease and transmission between vectors and humans and allow for various interventions, including passive surveillance (PS) and active screening (AS). The models' parameters are selected by fitting to the human case data (WHO HAT Atlas) recorded in each health zone (2000-2016).

Name	Interruption length	Active screening (AS) during interruption	Passive surveillance (PS) during interruption
Baseline	None	Mean of 2014-2018	Full (fitted current detection rate using MCMC)
2020 A	Until end of 2020	None from April 2020	Full
2020 A + PP	"	"	Partial (levels in 2000)*
2020 A + P	"	"	None*
2020-21 A	Until end of 2021	Jan-March only	Full
2020-21 A + PP	"	"	Partial (levels in 2000)*
2020-21 A + P	"	"	None*

Table 1. Strategies and interruption scenarios considered

We then consider potential interruption scenarios of gHAT activities due to COVID-19 within these frameworks. For a mean AS, no-interruption baseline, we assume these interventions

continue indefinitely from 2019 with the same number of people annually screened, given by the mean value of the last five years (2014-2018). We assume all interruptions start at the beginning of April 2020, but they may last until either the end of 2020 or 2021. The interruptions may disturb either AS or both AS and PS. Whilst AS would be fully suspended within the interruption period, PS may be partially operating, going back to the detection capacity assumed for 1998. Table 1 summarises these six interruption scenarios. The interventions are reinstated to the baseline values (mean AS and full PS) after the interruption period. Moreover, we study identical scenarios with mitigation, where AS is set to the maximum coverage observed in the data history after interruption finishes. This will allow us to study possibilities of catching up to previously expected progress, despite COVID-19, or even accelerating towards the 2030 goal. For comparison, we include another scenario with no interruption but maximum screening level from 2019.

We perform stochastic simulations for all these scenarios and predict how the gHAT infection dynamics may be influenced in each caseby different interruption scenarios. In particular, we analyse how new transmissions, reported cases, and deaths due to gHAT, are predicted to change over time during and following the interruption period (Fig. 1 showing the mean of 200,000 simulations).

Results

The results predict a significant increase in the number of new gHAT infections when both active and passive interventions are suspended; this increase is more pronounced for longer interruptions (until the end of 2021). If PS remains partially or fully operational it is unlikely that infection would increase, although the probability of reaching EOT by 2030 will reduce slightly compared to no interruption.

We predict EOT delays which are proportional to the length of the interruption when all screening and surveillance interventions are interrupted (Fig. 2). For Mosango, EOT may still be achieved by 2030, however, in Bagata the elimination goal is unlikely without intensifying interventions, even without interruptions. These results suggest that retaining functioning passive surveillance, even partially, can help to avoid significant delays in EOT and to prevent substantial increases in mortality. Mitigation through increasing coverage of active screening following interruption could also improve the probability of meeting the 2030 EOT goal.

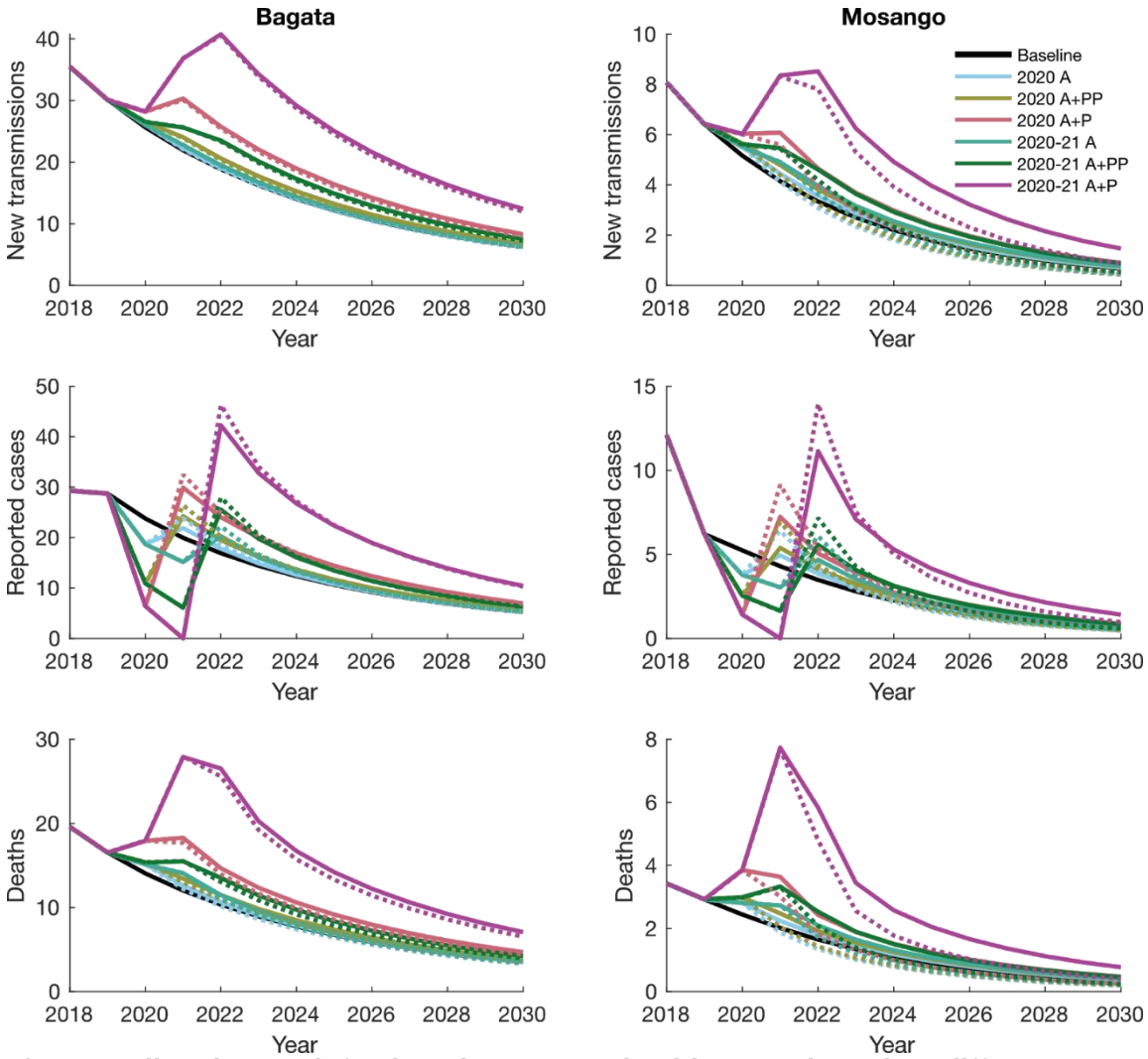

Fig 1. **Predicted gHAT infections in two DRC health zones based on different COVID-19 interruption scenarios.** The graphs show the expected number of new transmissions, reported cases, and number of deaths caused by the disease (mean values), for health zoness of Bagata (left hand side) and Mosango (right hand side). The baseline is shown as a black solid line. Individual interruption scenarios and the corresponding mitigation scenarios are depicted by various colours indicated in solid and dashed lines respectively.

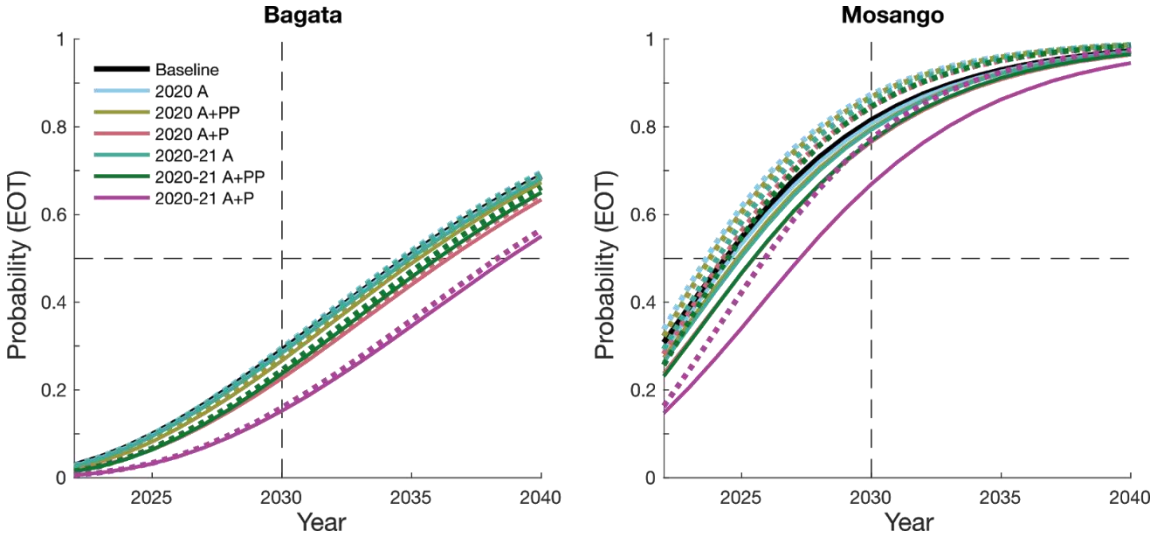

Fig 2. **Probability of elimination of transmission by year.** Results are plotted for the period of 2022-2040 for the health zones Bagata and Mosango under different interruptions and the corresponding mitigation scenarios (maximum AS after the interruption) shown by dashed lines.