PREDICTING THE PUBLIC HEALTH IMPACT OF ANOPHELES STEPHENSI INVASION ON THE TRANSMISSION OF FALCIHARUM MALAIA IN ETHIOPIA

Arran Hamlet and Thomas Churcher
with support from Seth Irish, Dereje Dengela, Aklilu Seyoum, Eric Tongren & Jennifer Armistead

*MRC Centre for Global Infectious Disease Analysis, Department of Infectious Disease Epidemiology, Imperial College London, London, United Kingdom
*arran.hamlet14@imperial.ac.uk
Sinka et al., (2020) modelling exercise found high suitability across large parts of Africa, particularly in large cities
- Primary vector of urban malaria in India

Evidence that An. stephensi is playing a role in malaria transmission in Djibouti

Occurrence of Anopheles stephensi in Djibouti City

Annual confirmed malaria cases in Djibouti, MoH

Can we attempt to quantify what has potentially happened in Djibouti in order to project what could happen in Ethiopia? (not a forecast or prediction of what will happen)
**METHOD**

Fit deterministic malaria model to Djibouti malaria incidence to produce estimates of vector density
- (Griffin et al., 2014, Challenger et al., 2021, Griffin et al., 2010, White et al., 2011), multiple runs to account for uncertainty in mosquito bionomics. Daily mortality (1), Anthropophagy (2), Endophily (3), Proportion of bites taken indoors (4) and in bed (potentially protected by a bednet) (5)

Extrapolate vector density from Djibouti fitting to Ethiopia to produce predictions of how malaria incidence may change
- Account for pre-existing IRS/ITN/treatment/prevalence and temperature dependent EIP

Scale up interventions and apply these to new predictions of malaria transmission

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**Incorporated data**

- IRS coverage
- Treatment coverage
- ITN use
- EIP
- Falciparum prevalence (2-10 years) Malaria Atlas Project

Currently being updated with Ethiopian National Control Programme data so estimates will likely change
RESULTS

Huge uncertainty around results

Substantial increases in prevalence across Ethiopia with large amounts of subnational heterogeneity

Large increases seen in areas with low existing transmission
  - Except those at altitude where low temperatures lead to a high EIP, limiting potential impact

Increase in incidence depends on population expected to be at risk
  - 1.0 – 6.1 million additional malaria cases per year (95% CI 0 – 40 million)
  - Currently ~2.1 million cases of falciparum malaria per year in Ethiopia (World Malaria report 2020)
RESULTS

Considered different combinations of interventions at different coverages (0/40/80%)

Pre-existing intervention and transmission important to consider

However, in all cases a combination of interventions is needed

Cost of implementing these interventions is substantial, measured in the $10’s – $100’s of millions
CONCLUSION

Large parts of Ethiopia are vulnerable to substantial increases in malaria if An. stephensi establishes itself across the country

Huge uncertainty in estimated impact

Large scale up of interventions needed following estimated increases

Additional surveillance and data needed

- This study is a first step of a long process of estimating the impact of An. stephensi
- Work estimates large increases, but huge uncertainty around this, in order to improve estimates more data on vector bionomics and the actual impact of stephensi to transmission in Africa needed

Several limitations

- Many assumptions due to limited data
  - These, and the method utilized, lead to huge levels of uncertainty in predictions
- Single vector considered, no accounting for inter-species competition
  - Assuming increase in Djibouti is purely due to stephensi
  - Unknown if stephensi will contribute to malaria transmission in Ethiopia, and invasion dynamics will most likely be different to those in Djibouti
- Invasion dynamics are very simple
  - No accounting of geographic spread or differential suitability in administrative units, no seasonality
  - Invasion and establishment in Ethiopia is likely to be very different to Djibouti, but the absence of data has necessitated assuming it will be the same

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  - control the spread of Anopheles stephensi in Ethiopia and Sudan