Supplementary Information. Simian Malaria: A Narrative Review on Emergence, Epidemiology and Threat to Malaria Elimination

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Search strategy and scope.

Within this study, we aimed to describe the epidemiology of simian malaria and identify priorities for future surveillance and control. For the purposes of this review, we defined simian malaria as malaria with evidence of infection in both humans and non-human primates (NHPs) outside of experimental laboratory studies. Based on expert consultations, we identified priorities for surveillance and control including diagnostic methods, molecular epidemiology, impacts of environmental change, mathematical modelling and control strategies. We additionally reviewed the wider literature on simian malaria and identified areas reporting the highest public health burdens from simian malaria: *P. knowlesi* in Malaysia and *P. simium* and *P. brasilianum* in Brazil. Authors based in Malaysia and Brazil led case studies on these regions, focusing on the epidemiology, clinical burden and vector and NHP hosts.

We additionally identified several recent systematic reviews on simian malaria which included full databases of reported human cases[1-4]. We additionally searched PubMed and Web of Science for articles published up to January 2023, using the terms “malaria”, “zoonotic malaria”, “simian malaria”, and “*Plasmodium*” in combination with “non-human primate”, “vectors”, “*Anopheles*”, “humans”, “theoretical models”, “molecular”, “treatment”, “control”, “surveillance” or “diagnosis” and “global” or specific country or region names.

Spatial database of human simian malaria occurrence

To examine the broad geographical distribution of simian malaria, we assembled a geolocated database of all occurrences of human cases of *P. knowlesi*, *P. simium* and *P. brasilianum*. Within this database, confirmed cases were limited to naturally acquired human cases with molecularly confirmed results and locations of infections. We updated databases from previous systematic reviews with more recent results from literature searches. For all records, human cases of simian malaria were geolocated using coordinates or reported locations of infections (e.g. residence address, district or village). For extensive datasets, such as analysis of Malaysian surveillance data, we overlaid a 4km^2 grid on the entire country and recorded grid cells where cases were reported to have occurred. For other zoonotic species, such as *P. cynomologi* and *P. inui*, we assembled data on countries and years of reporting for all reported human cases from published literature and datasets (Table 2).

Geographic suitability of simian malaria

It is assumed that occurrence of simian malaria is related to environmental factors. This is reasonable because these factors influence mosquito vectors, NHP habitats and thereafter the dynamics of transmission. *Plasmodium* occurrence and geolocation data and environmental predictors (climate, elevation, and biome data) were imported into the R v. 4.0.4 program (The R Foundation for Statistical Computing, Vienna, Austria) with packages maptools, raster, rgdal, shapefiles, maps, and dismo. Climate data as annual mean temperature, maximum temperature of warmest month, minimum temperature of coldest month, annual precipitation, precipitation of wettest month, and precipitation of driest month, for 1970–2000, were obtained from WorldClim v. 2.1 (worldclim.org). Elevation data derived from the Shuttle Radar Topography Mission were also obtained from WorldClim. Lastly, biome data were obtained from the Terrestrial Ecoregions of the World project (worldwildlife.org/publications/terrestrial-ecoregions-of-the-world).

Following, maximum entropy (MaxEnt v. 3.4.3) algorithm was utilized for the modelling of *Plasmodium* occurrence and geolocation data in function of environmental data and background locations. The fitted model was employed to predict the geographical suitability of simian malaria in the studied regions, for example, Latin

America and the Caribbean and Southeast Asia. *Plasmodium knowlesi* was particularly associated with intermediate levels of precipitation of driest month (>80% contribution). The Amazon and Atlantic Forest were distinctly suitable ecoregions for *P. brasilianum* and *P. simium*, respectively; however, the former is associated with higher levels of precipitation of wettest month (25% contribution), whereas the latter is associated with higher values of minimum temperature of coldest month (35% contribution).

References.

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