

## Towards the end game: operational research on improving rural housing in sub-Saharan Africa as a strategy to support malaria elimination

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### Project Background Information/Introduction:

Most of malaria infection in sub-Saharan Africa occurs indoors and at night<sup>1-3</sup>. In 2018, this region accounted for 213 million malaria cases and 380,700 malaria-related deaths<sup>4</sup>. Malaria has consequences for the health status of the population, as well as in education, production, economy, and development. Despite major reductions in malaria infection achieved by the massive deployment of insecticide-treated nets (ITNs), indoor residual spraying, and prompt and effective treatment with antimalarials between 2005 and 2015<sup>5</sup>, malaria control has stalled in sub-Saharan Africa. New approaches are needed to reduce malaria.

Malaria mainly affects poor people living in rural areas; many of them depending on subsistence agriculture and facing vulnerable conditions whether related to economy, access to health care, access to education, infrastructure, inequality or a combination of them<sup>6</sup>. Because of malaria, people's productivity decreases, affecting workdays and family's financial situations. At the same time, this impacts general living standards and opportunities for a better future for children and youth, specially related to education levels<sup>6</sup>.

About 80% of malaria transmission occurs indoors. The Anopheles mosquitoes that transmit malaria locate a human by detecting human odours and use it as guide to find their source of blood<sup>7</sup>. This is why having a ventilated house is as important as having a screened one. A ventilated house will be cooler, increasing the chances of using bed nets and reduces human odours. A multisector approach, combining research in mosquito-transmitted diseases and the built environment, may lead to novel ways to protect people from malaria in their homes.

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### Research Aim/Objectives/Questions/Hypotheses:

This research aims to explore infrastructure elements that contribute to making houses protective against disease vectors. For our case study, we identified three main points for which we have conducted individual studies and formulated hypotheses.

- Increasing the house height as a way of reducing indoor mosquito entry and cooling down the house.
- Screening of doors and windows as barriers for mosquito entry and ways to reducing the indoor temperature and carbon dioxide concentrations (reducing the odour trace).
- Using technology, such as fans, to reduce indoor temperature and restricting mosquito flight.

### **Data/Methods/Analysis:**

All individual experiments are conducted in collaboration with the Medical Research Council Unit of The Gambia at the London School of Hygiene and Tropical Medicine. The field studies take place in the Central River Region and in experimental houses of a similar design and size to traditional houses in the region. For most experiments, we have two volunteers sleeping under ITNs in each house, to attract mosquitoes and replicate real housing conditions. To avoid bias, sleepers' pairs rotate nightly between houses and housing typologies rotate each experimental session.

We collect mosquitoes in each house using CDC light traps and record temperature, relative humidity, and carbon dioxide levels using data loggers. Mosquitoes are identified and counted using common morphological guides, and female *Anopheles gambiae* are stored for further polymerase chain reaction (PCR) identification. Additionally, we use ethnographic observation to understand the context, focus groups discussions to assess each study, and semi-structured interviews to gain in-depth information on specific topics.

### **Contributions to the SDGs:**

Malaria control and prevention contributes to 16 of the 17 Sustainable Development Goals, especially to SGD 3: Good Health and Well-being. Our case study works mainly with health issues and creating communities resilient to disease vectors (SDG 11). A decrease in malaria cases means poverty reduction (SDG 1), increase of school attendance and performance (SDG 4), reduction of the gender gap (SDG 5), economic growth (SDG 8), and a general improvement in conditions for the affected populations.

### **Lessons learnt and key takes/reflections:**

This case study shows that research and technology can work in tandem with traditional knowledge to create solutions. Multisector collaboration can provide innovative solutions to complex problems. Malaria reduction or prevalence affects various SDGs and the challenge it represents should be targeted from multiple disciplines as well. Even when our study is context specific, it provides important questions for other geographical locations in sub-Saharan Africa and positive results that contribute in the advancement of knowledge of housing and malaria.

### Project Information:

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