MALARIA CONSORTIUM
PROJECT BRIEF

FORECAST: Forecasting outbreak risks from extreme climate with active surveillance technology

Improving early warning and control of mosquito-borne disease outbreaks caused by extreme weather in Uganda

Background

The frequency of extreme weather events is increasing in Uganda, posing significant health challenges. Heavy rainfall has caused flooding and landslides in recent years, resulting in population displacements and humanitarian crises, and creating conditions that foster the proliferation of mosquito vectors for diseases such as malaria, yellow fever (YF) and Rift Valley fever (RVF). Malaria is endemic in nearly all parts of Uganda, with extreme weather conditions such as prolonged heavy rainfall causing outbreaks.[1,2] RVF is transmitted to livestock, mainly by *Aedes* mosquitoes following heavy rainfall; outbreaks have killed large numbers of livestock, causing huge economic losses.[3] Subsequent human infections occur via contact with animal organs and blood. Uganda has been affected by repeated outbreaks of YF,[4] with transmission occurring during farming activities in forests and swampy areas.

The complexity of predicting vector-borne disease outbreaks stems from the intricate effects of extreme weather on mosquito lifecycles and disease transmission, compounded by factors such as population immunity, human and livestock mobility, and ecological changes. The challenge is exacerbated by the limitations of current surveillance systems and the scarcity of diagnostic tools, leading to delayed outbreak detection and response.

Country
Uganda

Donor
National Institute for Health and Care Research (NIHR)

Length of project
January 2024 – December 2027

Partners
Project partners: Uganda Virus Research Institute; Erasmus MC — University Medical Centre Rotterdam; Ministry of Agriculture, Animal Industry, and Fisheries; The Netherlands Red Cross — 510; Uganda National Meteorological Agency; Uganda Red Cross Society

Collaborators: Ministry of Disaster Preparedness and Refugees; Ministry of Health (National Malaria Control Division, Department of Integrated Epidemiology, Surveillance and Public Health Emergencies)

Strategic objectives
Data-informed decision-making, Health sector resilience, Policy and practice, Digital solutions

Project outline and objectives

Malaria Consortium and project partners aim to improve Uganda's resilience to mosquito-borne diseases in the face of escalating climate-related challenges, by strengthening the capacity of the country's surveillance system. This involves developing predictive models and a risk mapping system, as well as enhancing the national outbreak preparedness and response plan. Taking these steps will enable timely identification and mitigation of mosquito-borne disease outbreaks, reducing their impact on populations living in vulnerable circumstances.

The project's outputs include an epidemic risk mapping system based on a web-based forecast platform; and an improved outbreak preparedness and response plan with guidance on specific actions, which are based on various risk scenarios produced by the platform. The project specifically intends to:

- document past mosquito-borne disease outbreaks in Uganda and analyse their association with extreme weather
- create and validate a risk index and early warning models to forecast the outbreaks
- develop a platform that maps risks and generates predictions continuously, based on real-time surveillance data, for routine use by disease control programmes
- revise the national outbreak preparedness and response plan to incorporate appropriate recommended response actions linked with various risk scenarios
- facilitate adoption and use of the system by all concerned stakeholders
- engage communities to enable their active involvement in research activities and to encourage effective uptake of the project outputs.

Activities

The project partners will implement the project in three phases over a period of four years, taking a structured approach that combines scientific rigour with community involvement.

Phase 1:

- Create a risk index and forecasting models.
- Compile and analyse historical data on outbreaks of malaria, RVF and YF to ascertain the association between these diseases and extreme weather events.
- Use analysis to develop outbreak forecasting models focusing on these three diseases.

Phase 2:

- Develop a risk mapping system and an impact-based action platform that are based on the forecasting models, incorporating surveillance data and other relevant inputs.
- Establish a tool that disease control programmes can routinely use to predict outbreaks of the three diseases and plan an appropriate response.

Phase 3:

- Revise the national outbreak preparedness and response plan to align with the newly developed early warning capabilities.
- Extend the impact-based platform to include detailed intervention strategies, along with cost analyses and effectiveness evaluations tailored to forecast scenarios.

In parallel, a cross-cutting initiative will engage with communities directly affected by these diseases, as well as potential stakeholders and end-users of the research outcomes. By incorporating community insights and needs into the research process, we will ensure that the developed solutions are relevant, embraced and utilised effectively.

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References

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