Surveillance of vector populations and malaria transmission during the 2009/10 El Niño event in the western Kenya highlands: opportunities for early detection of malaria hyper-transmission

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Abstract:

Background: Vector control in the highlands of western Kenya has resulted in a significant reduction of malaria transmission and a change in the vectorial system. Climate variability as a result of events such as El Niño increases the highlands suitability for malaria transmission. Surveillance and monitoring is an important component of early transmission risk identification and management. However, below certain disease transmission thresholds, traditional tools for surveillance such as entomological inoculation rates may become insensitive. A rapid diagnostic kit comprising Plasmodium falciparum circumsporozoite surface protein and merozoite surface protein antibodies in humans was tested for early detection of transmission surges in the western Kenya highlands during an El Niño event (October 2009-February 2010). Methods: Indoor resting female adult malaria vectors were collected in western Kenya highlands in four selected villages categorized into two valley systems, the U-shaped (Iguhu and Emutete) and the V-shaped valleys (Marani and Fort Ternan) for eight months. Members of the Anopheles gambiae complex were identified by PCR. Blood samples were collected from children 6-15 years old and exposure to malaria was tested using a circum-sporozoite protein and merozoite surface protein immunchromatographic rapid diagnostic test kit. Sporozoite ELISA was conducted to detect circum-sporozoite protein, later used for estimation of entomological inoculation rates. Results: Among the four villages studied, an upsurge in antibody levels was first observed in October 2009. Plasmodium falciparum sporozoites were then first observed in December 2009 at Iguhu village and February 2010 at Emutete. Despite the upsurge in Marani and Fort Ternan no sporozoites were detected throughout the eight month study period. The antibody-based assay had much earlier transmission detection ability than the sporozoitebased assay. The proportion of An. arabiensis among An. gambiae s.l. ranged from 2.9-66.7% indicating a rearrangement of the sibling species of the An. gambiae s.l complex. This is possibly an adaptation to insecticide interventions and climate change. Conclusion: The changing malaria transmission rates in the western Kenya highlands will lead to more unstable transmission, decreased immunity and a high vulnerability to epidemics unless surveillance tools are improved and effective vector control is sustained