Malaria: Movement, Modeling, and Mapping

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The recent increases in funding for malaria control in sub-Saharan Africa have resulted in the majority of countries scaling up control efforts substantially, and some countries even considering eliminating the disease. To monitor the effects that this increased investment and control is having, and to help countries decide on whether to target elimination in the short term, a strong quantitative evidence base is required. This year, my research has been focused on continuing to help to build this evidence base and provide quantitative, policy-relevant guidance on the feasibility of malaria elimination and the effects of control.

Through my continued work with the Malaria Atlas Project (MAP, www.map.ox.ac.uk), we have built up a global database of nearly 30,000 community prevalence surveys, the majority of which were undertaken in Africa. Using Bayesian geosta-tistics, we constructed the first global evidence-based map of *Plasmodium falciparum* malaria transmission intensity in 50 years, and used it to derive detailed estimates of populations at risk, clinical case numbers and commodity needs that are now widely used in the policy domain. An unexpected obstacle in calculating estimates of populations at risk from our malaria maps, was the poor quality of existing population distribution mapping for the majority of African countries. This prompted me to initiate and the launch the AfriPop population mapping project (www.afripop.org) this year, which is based at UF. The project aims to produce detailed and freely-available population distribution maps for the whole of Africa, and the early versions of East African datasets have been downloaded hundreds of times, finding usage by multiple organizations, including the World Bank, United Nations agencies, USAID, the CDC, the Red Cross, Medecins sans Frontieres and many other humanitarian organizations.

Funding from the Bill and Melinda Gates Foundation has also enabled UF colleague David Smith (Biology and EPI) and I to utilize the MAP malaria maps, in combination with mathematical models, to develop quantitative methods for malaria elimination planning. In collaboration with the Government of Zanzibar and the Clinton Foundation, this year we helped to conduct the first malaria elimination feasibility assessment of its kind, focused on the islands of Zanzibar. With 21 million records on cell phone usage across Zanzibar and mainland Tanzania, we were able to use novel methods to quantify human movement patterns and estimate rates of malaria importation to the islands. The report is now serving as a model for other countries considering malaria elimination, and we are now working with the World Health Organization to update their guidelines.

Finally, through successful Africa-related grant applications, I have begun working on a multi-insti-

tution collaborative project focused on intensive studies of malaria epidemiology in Uganda, the historical epidemiology of cholera globally, and the role of air travel in the spread of insect-borne diseases to and from Africa.

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