Drones against vector-borne diseases

Eric Rasmussen

Uncrewed aerial vehicles can reduce the cost of preventative measures against vector-borne diseases.

In 2018, there were more than 200 million malaria cases reported in the world and more than 400,000 malaria deaths, two-thirds of whom were children under age 5 (1). Malaria is an ongoing tragedy of immense proportions, with the World Health Organization aggressively targeting its global eradication within the next decade. Reducing transmission of the malaria parasite Plasmodium, carried by Anopheles mosquitoes, is an important part.

Aedes mosquitoes are a different mosquito genus that transmits the viral diseases dengue, Zika, chikungunya, and yellow fever. Each of those diseases has recently been the subject of newsworthy outbreaks, and each is worrisome as we track their expanding range. In 1970, for example, only nine countries in the world had dengue cases. Now, there are more than 100 countries with dengue (Fig. 1), and 2019 saw the largest global number of dengue cases ever reported (2).

Both Aedes and Anopheles mosquitoes are predicted to expand their range still further in a warming world, and regrettably, although most mosquitoes will bite anything, Aedes prefers to bite humans (3). Writing in this issue of Science Robotics, Bouyer et al. describe a new, efficient, and inexpensive technique for the release of sterile male mosquitoes from an uncrewed aerial vehicle, or drone, that will reduce field reproduction through competitive mating with wild-type female mosquitoes. The resulting eggs cannot mature and the regional mosquito population falls (4). Bouyer’s technique may have broad applicability against Aedes, Anopheles, and other insects and so may help reduce vector-borne diseases.

But there may be unforeseen impediments. While Bouyer and colleagues have been doing good work with Aedes, the world has been responding to a zoonotic respiratory coronavirus pandemic, and massive resources have been allocated against this infectious threat. Underneath the global response against SARS-CoV-2, however, a subtle catastrophe is likely unfolding. We are already anticipating disruptions in mosquito bednet distribution, loss of prophylaxis and simple therapies for common medical problems, and reductions in management of serious illnesses as a result of both lockdowns and of care providers focused on COVID-19 (5). The resulting excess mortality may be severe.

I was part of a team that worked with the Obama White House in 2014 on the global response to the Ebola virus outbreak in West Africa. What we missed then, and learned later, was the cost of that outbreak on conventional medical care in the region. Anecdotal reports in Guinea a year after Ebola showed that conventional health care had suffered severely as a result of re-directing scarce medical resources to that looming viral threat. Outpatient visits for children under age 5 at a district hospital dropped from 200 per day to a dozen per day, and patients presenting to hospital with malaria, diarrhea, and pneumonia dropped 75% from baseline (6). Later, a rigorous paper in The Lancet by Walker and colleagues modeled the malaria-specific toll taken by the loss of ordinary medical care during the Ebola crisis in Guinea, Liberia, and Sierra Leone. At the low end of their sobering findings, they estimated 2.6 million additional cases of malaria and more than 5000 excess malaria-attributable deaths, just in West Africa (7).

As seen in the Ebola outbreak, it is likely mosquito-borne diseases during this pandemic are going to take an outsized toll that we will not discern clearly for years and that makes the work by Bouyer and co-workers exceptionally important. Their findings may help reduce the ravages of mosquito-borne disease through the reduction in viable mosquito eggs. Although this is only one facet of vector-borne disease eradication, it is a critical part. Their work shows that we are getting closer to cheap and efficient methods to mitigate the damage done by mosquitoes, even when, like now, normal medical resources are under stress.

Bouyer and colleagues introduce a new method for dispersing sterile males from a drone-based system. Their drone technique was designed, assembled, and deployed using ordinary materials. This system was designed, assembled, and deployed using ordinary materials. Their work shows that we are getting closer to cheaper and efficient methods to mitigate the damage done by mosquitoes, even when, like now, normal medical resources are under stress.
for sterile release, though, is cheap enough to allow a reduction in the misery of mosquito-borne diseases almost anywhere. That is exciting news.

REFERENCES AND NOTES
1. World Health Organization, World Malaria Report 2019 (2019); pp XII.

Acknowledgments
Competing interests: E.R. is CEO, Infinitum Humanitarian Systems; Chief Medical Officer, Briotech Inc.; Chair, Board of Directors, InSTEDD; President and Chairman of the Board, iRespond; Team Lead, Global Disaster Response Team, The Roddenberry Foundation; Research Professor, Environmental Security and Global Medicine, San Diego State University, San Diego, CA; Senior Fellow, GeoTech Center, The Atlantic Council; and Senior Fellow, Florida Institute for Human-Machine Cognition, Pensacola, FL.

Citation: E. Rasmussen, Drones against vector-borne diseases. Sci. Robot. 5, eabc7642 (2020).
Drones against vector-borne diseases
Eric Rasmussen

DOI: 10.1126/scirobotics.abc7642