



A self-sustaining system to reduce migration of *Anopheles stephensi* in East Africa.

Dear editor

The history of the long range dispersal of disease vectors by humans is a long and continuing one.

It is now recognised that the malaria vector *Anopheles stephensi* is spreading in Africa. The potential scale of the problem cannot be exaggerated. It is an urban vector, larvae are found in manmade cisterns and reservoirs such as are found in towns where the municipal water supply is erratic. It bites outdoors in the early evening, so conventional techniques are ineffective against it. It is now established in Ethiopia. It arrived from India by boat and is now traveling from Ethiopia by road.

Its arrival in Kenya from Ethiopia follows the highway. Even if the Kenyan outbreak is eliminated, the *An. stephensi* from Ethiopia will always be a 'source' population and so re-invasion is always likely. Stopping the spread of the mosquito is a priority.

Spatial repellents, that also kill mosquitoes, and which work for three weeks to a month and don't need heat to work, are now available (IVCC, 2020; Charlwood et al., 2014, 2016). In confined spaces like lorry cabs they should be very effective. In many cars and lorries, in many countries, drivers buy air fresheners to hang under the mirror. Why not an emanator that repels and kills mosquitoes? While this is a good thing in itself it needs to be voluntary and self-sustaining.

In a speech outlining the prospects for 2023 given to the United Nations on the 5th of February, Antonio Guterres, the Secretary General said 'We have started 2023 staring down the barrel of a confluence of challenges unlike any in our lifetimes'. He called for a 'radical transformation' of Global finance, saying that 'Something is fundamentally wrong with our economic and financial system'. According to Lietaer et al. (2012) the problem is because we live in a monetary 'monoculture' rather than a more stable monetary 'ecosystem' with different 'currencies' of value which can be earned outside of the usual monetary system. 'Air-miles' are already one such system – but they are a system that encourages environmentally destructive behavior. How such a system might work with emanators, and in doing so might reduce migration by *An. stephensi*, is outlined below.

Emanator's that smell, or look good, suitable for use inside lorry cabs, are sold at recognised vendors. The emanators come in plastic bags that have a saturated atmosphere of the product. They can be stored for long periods in this way. At the point of sale the vendor scans a barcode or QRcode on a sheet of such codes. This is sent to the phone of the driver, and a central database, available to epidemiologists and the like. Should the lorry be stopped (at customs, say) then the presence of an emanator gives the driver Wellness Tokens. The driver only gets Wellness tokens, however, if it can be confirmed by his barcode that the emanator is less than a month old. Drivers who do not have an up to date

emanator, or any emanator at all, just do not get tokens. They may be given a leaflet explaining why having one is a good thing. How valuable the tokens are, or become, may depend on how often they can be earned and what they can be used for. Wellness tokens then function in a system such as that described by Lietaer et al. (2012).

Such tokens might be gained in a variety of ways. If they become more valuable than their cash price then the incentive to have an up to date emanator is greater than the deterrent of spending money to buy it. If there is to be a subsidy of such things it should go towards the value of Wellness Tokens not the manufacturer. This would help to make the tokens more valuable.

Making such an up to date emanator mandatory for cross-border passage, like a vaccine certificate, destroys the above system because uptake is involuntary and it works on punishment rather than reward. It is vulnerable to conspiracy theories and may break down if the official demand is reduced. Reward at the border may be a no brainer. Whilst setting up such a system on highways out of Ethiopia might be a priority, the use of such emanators in numerous other sites (especially ports, where the port authority provides the Tokens, to drivers who enter the port with an up to date emanator) should also be encouraged. Indeed, they may be useful anywhere where mosquito vectors hitch a ride in motor vehicles (the spread of *Aedes albopictus* in Europe may be one instance).

It may still not be too late to stop *An. stephensi* spreading further. If it makes it to major towns malaria elimination becomes a dream, or rather, nightmare.

Declaration of Competing Interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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