Zooprophilaxis and the insecticide resistance -- an evolution-free control of vector-born parasites.

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A strategy to eradicate the vector-borne epidemic diseases, for example, malaria and Japanese encephalitis transmitted by mosquito, is to control the vector by insecticides. However, if the insecticide is sprayed thoroughly, the insecticide-resistance evolves in the vector species, and the disease control fails.

Sota and Mogi (1989, 1991) proposed a model for the control of malaria by "zooprophilaxis". The zooprophilaxis means the disease control by attracting the vector to livestock (e.g. cattle) which is the dead-end host of the disease (in which the pathogen cannot amplify). *Plasmodium*, the causative agent of human malaria, has a closed transmission cycle between human and mosquito, and hence cattle can serve as the dead-end livestock. They showed that by placing sufficient number of livestock besides the human living site, malaria can be eradicated.

In this study, we extend the Sota-Mogi model to include mosquito control by insecticide, to examine the possibility to eradicate malaria with a fewer mosquito. In addition, we also take into account the evolution of the insecticide-resistance in the mosquito. The model reveals that by a suitable choice of the insecticide spray rate and the cattle density, malaria can be eradicated without allowing the evolution of the insecticide-resistance in mosquito. It is important to spray insecticide only in human living site, keeping livestock site insecticide-free, whereby the resistant mosquito cannot increase because it is competitively inferior to wild type in livestock site. We conclude that the evolution-free control of malaria is most easily attained by spraying a small amount of insecticide in human site and placing sufficient number of cattle.