Spatiotemporal Patterns of Insecticide Resistance

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Insecticide resistance amongst vector species is currently threatening vector control, by reducing the efficacy of the limited number of insecticides available to control the vectors.

How do we deal with this?

A key question is “What is the scale of the problem?”
Global Maps

Substantial data requirements

n = 14,473
Data by class

- **Carbamates**
  - n = 1,997
  - insecticides = 3

- **Organochlorines**
  - n = 3,151
  - insecticides = 5

- **Organophosphates**
  - n = 2,470
  - insecticides = 6

- **Pyrethroids**
  - n = 6,635
  - insecticides = 8
Temporal Trends in Reporting

1996 - 2015

- pyrethroid bioassays
- organophosphate bioassays
- carbamate bioassays
- organochlorine bioassays
Temporal Trends

Pyrethroid Bioassay Data

Year

Mortality (%)

0 20 40 60 80 100

Pyrethroid Resistance
Pyrethroid resistance mechanisms

Altered target site

Over expression / elevation of monooxygenase
Species class

n = 14,473
no. species/complexes = 74
no. data points for species with behaviour data = 6,421
Aim is to characterise spatiotemporal patterns of resistance in different regions of the world using a Bayesian geostatistical approach:

• produce regional maps of insecticide resistance for malaria vectors;
• investigate the drivers of selection, such as insecticide and pesticide coverage and environmental factors, using a cartographic approach;
• generate estimates for variation in resistance, bounded by a measure of uncertainty, that can be combined with estimates of the impact of insecticide resistance.

And we will release the data that goes into these models and the predictions produced by them.
A Bayesian geostatistical model

Our starting point is a Bayesian geostatistical model previously used to analyse *Plasmodium falciparum* prevalence.

This model and large volumes of parasite prevalence data were used to estimate variation in space and time.

Insecticide resistance in other vectors

Deltamethrin resistance in adult *Aedes aegypti*. 
Many to thank

Funded by the Wellcome Trust

The core team: Penelope Hancock, Antoinette Wiebe, Katherine Gleave, Janet Hemingway, Michael Coleman, Peter Gething, Catherine Moyes and colleagues

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