Vector Ecology and Control Network (VECNet)

Vision Statement
To use spatially explicit data to understand and model the impacts of interventions on malaria transmission for control and eradication

http://www.vecnet.org/
What is VECNet?

A consortium of institutions to analyze malaria transmission and its reduction by one or several vector control interventions.

VECNet Goals

1. Establish a **Digital Library** of malaria-specific data,
2. Establish an **Integrated Modeling Platform**
3. **Analyze data to estimate the potential impact** of vector control tools on a spatially explicit scale
Primary Dominant Vector Species

The Americas
- An. albimanus
- An. albifasciatus
- An. aquasalis
- An. darlingi
- An. freeborni
- An. marajoara
- An. nuneztovari
- An. pseudopunctipennis
- An. quadrimaculatus

Euro. & M. East
- An. atroparvus
- An. labranchiae
- An. messeae
- An. sacharovi
- An. sergentii
- An. superpictus

Africa
- An. arabiensis; An. funestus;
- An. gambiae
- An. arabiensis, An. funestus
- An. funestus, An. gambiae
- An. arabiensis
- An. gambiae
- An. funestus

India/Western Asia
- An. culicifacies; An. stephensi;
- An. fluviatilis
- An. culicifacies
- An. fluviatilis
- An. stephensi

South-East Asia and Pacific
- An. farauti; An. koliensis;
- An. punctulatus
- An. dirus; An. minimus
- An. lesteri; An. sinensis
- An. balabacensis
- An. balbacinus
- An. barbiostris
- An. dirus
- An. farauti
- An. flavirostris

Malaria Atlas Project
Model based surface of *P. falciparum* endemicity - 2010

Gething/Patil/Smith *et al*.
Multiple data on Entomology, Climate, Topography, Demography, Epidemiology, Interventions

- Framework inputs
- Intermediate outputs
- End-user tools

Interventions: Epidemiology, Local Environments

Integrated epidemiological & vector species datasets/maps
- Vector species datasets/maps
- Vector locations
- Location-specific boundaries & data

Entomology:
- Vector ecology profiles
- List of reproduct. isolated groups
- Expert-derived vector ranges

Local Environments:
- Political map
- Precipitation
- Climate
- Topography
- Hum. population
- Local resistance to AIs
- Altern. interven.
- Parastal rates and coordinates
- Expert-derived epidemic. ranges

Parasite epidemiology:
- Parasite ecology profiles
- Epidemiological map

Interventions:
- Profiles of current interventions
- List of interventions
- Intervention efficacy

Data gaps:
- Vector ecology profiles
- Epidemiological & entomological

Intervention utility map

Intervention gap assessment
The Models

1. The EMOD Model (Global Good)

Vector development: Eggs of a similar state that hatch in the same time step begin larval development as a cohort. At each time step, mortality reduces the population, and the cohort progresses through the life cycle in increments of the temperature-driven rate. As development completes for a cohort, emergence occurs, and the cohort begins the latency to bloodfeeding as immature emerged adults. This latency can last for several hours up to several days, at which point the cohort begins the bloodfeeding cycle. Adults infected in a time step are removed from their cohort and compose another newly infected adults cohort. This new cohort proceeds through the infected development queue, with mortality reducing the population and temperature-dependent sporogony. Once sporogony is complete, the cohort becomes permanently infectious until the population is reduced to zero, and the cohort is de-allocated.

2. Swiss THP Model
Users: Researchers
Use case scenario: to analyze transmission risk as a function of vector ecology and behavior
Output: Vectorial Capacity
Users: National Malaria Control Programs

Use case: to evaluate the distribution of vector control interventions against the distribution of vector species with particular behaviors, ecologies

Outputs: parasite rates (incidence, prevalence)
User: Product Developers, to provide input about the potential impact of candidate new tools, to inform prioritization of investments
User: Policy Makers and Funders,
Use Case: to analyze the composition of tools needed to achieve malaria eradication globally; value and cost of new tools
Why am I here talking to the VCWG about VECNet?

I’m looking for stakeholders
## The Digital Library

<table>
<thead>
<tr>
<th>Factor category</th>
<th>Factor</th>
<th>Details</th>
<th>Current progress</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vector parameters</strong></td>
<td>Published data</td>
<td>Fully searchable details for each reference to be held in library (min: authors, title, abstract). Each ref to be tagged with specified metadata. Includes WHOPES, Cochrane Reviews, Grey literature.</td>
<td>6500 references pertaining to Anopheles bionomics have been indentified. Needs to be expanded to capture epidemiology data.</td>
</tr>
<tr>
<td></td>
<td>PDF collection</td>
<td>Copyright details still to be finalised and agreed with each individual journal before uploading into open access format.</td>
<td>approx 5000</td>
</tr>
<tr>
<td></td>
<td>Bionomics look-up tables for dominant vectors</td>
<td>Under development</td>
<td>Key parameters identified. Trial extraction commenced.</td>
</tr>
<tr>
<td></td>
<td>MAP surface data</td>
<td>Dominant vector species</td>
<td>Available</td>
</tr>
<tr>
<td></td>
<td>Existing databases - Namawala Namawala, Tanzania - 1990-94</td>
<td>Available</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Existing databases - VectorBase</td>
<td>Genomic information</td>
<td>Available. See <a href="http://www.vectorbase.org/">http://www.vectorbase.org/</a></td>
</tr>
<tr>
<td></td>
<td>Existing databases - Garki Garki District, Northern Nigeria - 1969-76</td>
<td>Available. See <a href="http://rhgarki.crc.nd.edu/">http://rhgarki.crc.nd.edu/</a></td>
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</tbody>
</table>

### Intervention data

- See published data and pdf collection above
- See Malaria Indicator Survey data below
- See World Malaria Reports below

### Epidemiology

- **PfEIR, PfPR2-10 surface data** Developed by MAP
- **DHS Surveys** See measured DHS
- **Malaria Indicator Survey data** Country-wide surveys conducted to provide a cross-sectional picture of malaria transmission and indicators in each country.
- **World Malaria Reports** WHO

### Climate / weather data

- **Satellite data (NDVI)** Available through MAP: contains altitude, temperature, precipitation. Data is split by grids
- **NASA** Available through IV/GG

### Demography

- **2010 population** Derived from Global Rural Urban Mapping Project via MAP by administrative units
- **Urban/peri-urban/rural status grids** From Global Rural Urban Mapping Project by administrative units via MAP

### Model Outputs

- **Any** Facility for user to upload data as model inputs
I want you to consider contributing data to the DL and using your data to run simulations

Global Access is a principal goal of the VECNet and is necessary to help facilitate (i) the broad availability of data and information to the scientific community and (ii) the access to affordable health solutions for the benefit of people most in need within the developing world.

(from the VECNet Master Collaboration Agreement)
I want your help in designing VECNet
Welcome to The Garki Project

Overview

The Garki Project was a study carried out in the Garki District of northern Nigeria in 1969-76 by a joint WHO and Nigerian Government research team. With a focus on the epidemiology and control of malaria in the African savanna, the Project was the most comprehensive study of the effects of a residual spraying campaign and mass drug administration (MDA) on malaria transmission. Project aims were to study the epidemiology of malaria in the lowland rural Sudan savanna (concentrating on the measurement of entomological, parasitological and seroimmunological variables and on their relationships); to measure the effect of house-spraying with propoxur (to control the vectors Anopheles gambiae and A. arabiensis) alone or in combination with MDA; and to construct and test a mathematical model of the transmission of malaria to compare various control strategies in terms of their expected effects.

Objectives

The specific objectives of the project, as actually implemented, may be described as follows:

- To study the epidemiology of malaria in the lowland rural Sudan Savanna. The study concentrated on the measurement of entomological, parasitological, and seroimmunological data, and their relationship to each other and on malaria transmission.
- To measure the effect of spraying with a residual insecticide (Propoxur), alone and in combination with mass drug administration (sulfalene and pyrimethamine) at two different frequencies.
- To construct and test a mathematical model of malaria transmission.

The Garki Information Resource is an attempt to make data publicly available from the Garki Project. The data can be queried and specific sets downloaded. Certain sets of data can be compared to each other to look at results from the various treatments and areas on various aspects of the data.
What if Garki IRS was continued?
Vector Behavior and Control: Impact of Frequency of Sugar Feeding on Effectiveness of Toxic Sugar Baited Traps

- **Baseline**
- **Sugar Trap 0.1 On Emergence**
- **Sugar Trap 0.1 Every Feed**
- **Sugar Trap 0.1 Every Day**

**Daily EIR**

**Days**

3000, 3500, 4000, 4500, 5000, 5500, 6000, 6500
Modeling Impacts of Multiple Interventions