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Advanced tools for the control of insect borne disease



IVCC
COMBATING INSECT
BORNE DISEASE
The Innovative Vector
Control Consortium

Insecticides and Information Systems are crucial weapons in the fight against insect borne disease such as malaria and dengue

Insect transmitted diseases, such as malaria and dengue are major public health issues throughout much of the world. Mosquito control can produce spectacular reductions in the transmission of these diseases if it is properly applied. Accurate, cost-effective monitoring and evaluation of a number of parameters is essential, including baseline and ongoing information on mosquito densities, levels of operationally significant insecticide resistance, the cost and availability of different insecticides and available deployment capacity.

If decisions on insecticides procurement, either as indoor residual spray formulations or on impregnated bednets are made without this information there is the potential for major wastage of resources through the purchase of ineffective or inappropriate treatments. The current range of technologies developed by the IVCC are designed to make baseline and ongoing monitoring simpler and more cost-effective in resource poor settings.

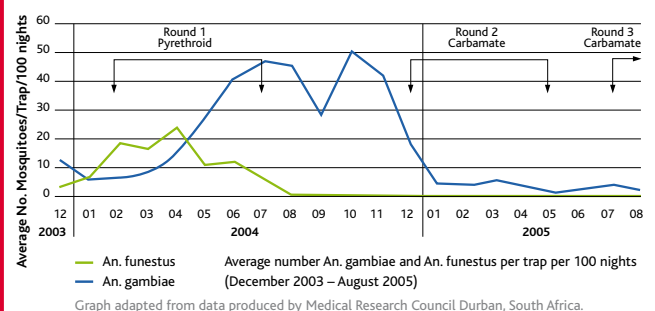
Opportunities and challenges for new insecticides and Information systems

Successful control of disease carrying insects (vectors) depends on deploying effective Public Health Pesticides (PHPs) and information systems capable of informing and guiding their deployment. A well documented example of this is illustrated in figure 1 which shows changes in mosquito populations on Bioko Island. In 2004, houses on the island were sprayed with a pyrethroid. However, the *An. gambiae* mosquito population were resistant to that insecticide and survived, resulting in little reduction in malaria transmission, effectively losing a whole year of control programme effort. In the following years, a carbamate insecticide was used to bring the mosquito population and the transmission of malaria under control. Had appropriate tests to detect resistance been used and alternative insecticides deployed in 2004, the lost year of effort would have been saved.

Establishment and Evolution of the IVCC

The IVCC was established to develop new tools and products to address the needs identified for vector control.

Figure 1



This data illustrates two crucial risks to effective vector control in general:

- Unless disease control campaigns collect advanced information about both insect populations and disease transmission in their monitoring and evaluation schemes, they are at high risk of control failure from deployment of ineffective products
- The emergence of insecticide resistance to all the currently approved Public Health Pesticides poses a great threat to our ability to control disease vectors



Advanced Monitoring and Evaluation Tools available from the IVCC



Sentinel Sites for Vector monitoring

Vector Population Monitoring Tools

Infection Rates and Malaria Indicator Surveys

Control Campaign intervention data

Entomology Abundance

Species, Infection, Resistance

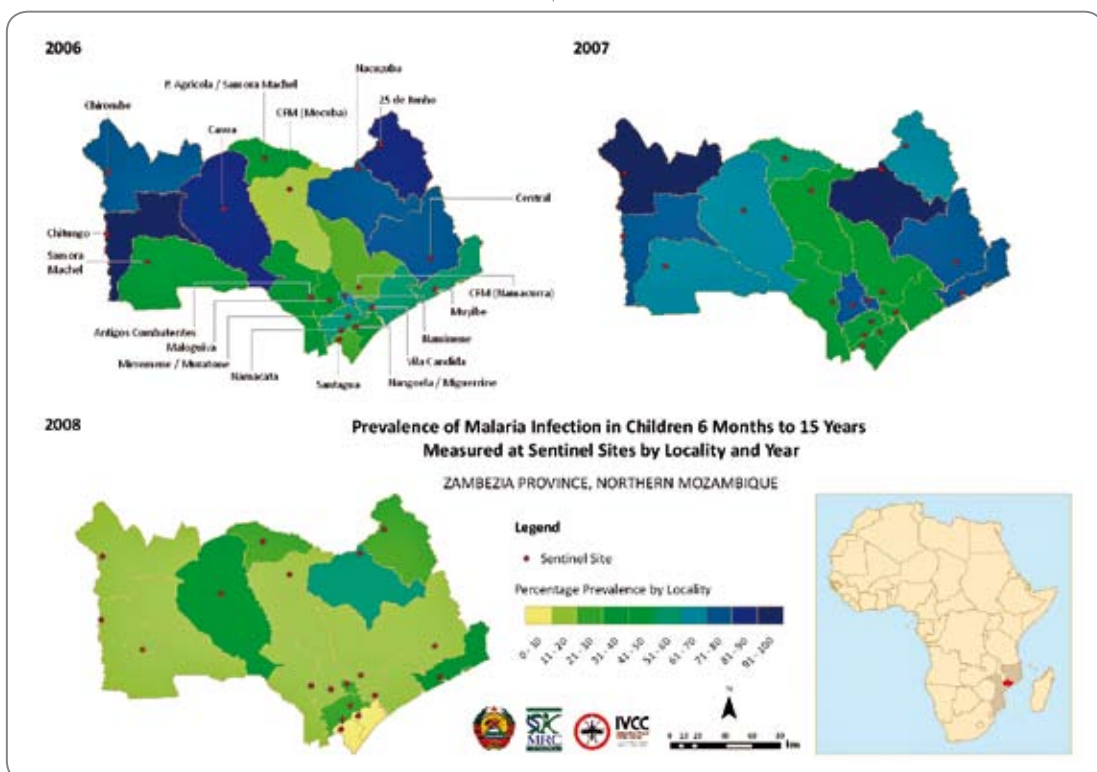
Parasitaemia MIS survey

Intervention Data

Malaria Decision Support System Database



Output is graphs/tables and maps to support the local NMCP + standardised data format for regional analysis.



Vector Population Monitoring Tool (VPMT)

The IVCC's Vector Population Monitoring Tool project has developed a simple, field applicable tool kit to be used to monitor the status of local mosquito vector populations. A single-platform assay determines the:

- mosquito species
- plasmodium infection status
- presence of all known target site insecticide resistance mutations for major African vectors

We have field-tested the prototype of the tool in Malawi and South Africa. These assays are very simple to perform and in repeated blind trials have proven to be more reliable than any of the alternative diagnostics currently available. Importantly, the cost per mosquito analysed is comparable, or in most cases lower, than any of the alternatives. It is clear from feedback from malaria control programme managers that there is an immediate demand to incorporate these improved assays into existing vector monitoring programs.

Malaria Decision Support System

Sentinel Site System

The IVCC has developed a system for establishing local sentinel sites for collection of entomological data and samples for analysis using the VPMT. The system has been implemented in Equatorial Guinea, Mozambique, Malawi and Zambia and demonstrated to provide effective raw data to supply the MDSS databases.

Database and Geographical Information Software

The IVCC MDSS software package collects, correlates and redistributes data collected by disease control programmes to allow programme managers to make informed decisions concerning the interventions they choose to deploy. The information that can be handled by MDSS includes entomological, vector population (using the tools in the VPMT project), vector control intervention, malaria indicator and clinical report data, all of which can be presented using a Geographical Information System (GIS) to give spatially useful information.



Dengue Decision Support System and Dengue Models

Just as malaria control depends on access to up to date entomological and disease monitoring data, so dengue control is enabled by collection of the same data types, however the epidemic nature of dengue calls for very rapid feedback to the disease control campaigns in order to inform appropriate control intervention. The IVCC has developed a set of data collection tools and database software designed for the collection of data relevant to dengue control.

Pyrethroid Quantification Kit

A key part of the information required by the control campaign concerns the residual effectiveness of insecticides used in nets or sprays. Until now there was no simple way to assess this in the field. This project has delivered a simple, field applicable kit that will indicate the amount of active insecticide remaining on the net or wall.

Available Now

- Vector population monitoring tools for species, infection status and target site resistance
- Sentinel Site Systems

Under Development

- Vector population monitoring tools for metabolic resistance
- MDSS software
- Dengue DSS software and models

Future Opportunities

- Vector population monitoring tools for other species and resistance mechanisms

Public Health Products portfolio



A key objective of the IVCC is to develop new insecticides and related PHP tools for deployment as vector control interventions. We have identified that the key barrier to innovation in this arena is the high risk associated with product R&D, hence the need to fund the early phases of new product development.

IVCC new PHPs fall into two classes:

- 1 Repurposing of agricultural insecticides, where new formulations are developed and tested with the aim of increasing residual effectiveness of the products to six to twelve months and increasing the range of known active ingredients that are available for public health application.
- 2 Discovery and development of entirely new Active Ingredients (AIs).

The current IVCC repurposing portfolio consists of:

- Five reformulation projects for Indoor Residual Spraying (IRS)
- Two projects for use in Long Lasting Insecticidal Nets (LLIN)

The IRS projects represent a variety of approaches to achieving longer residual activity and a broad range of AI classes. So far two of the

projects have exceeded the six month minimum goal in laboratory trials and moved on to field trials which continue successfully. Within these projects the major industrial suppliers of public health pesticides to the developing world, such as Bayer, Syngenta and others are all represented.

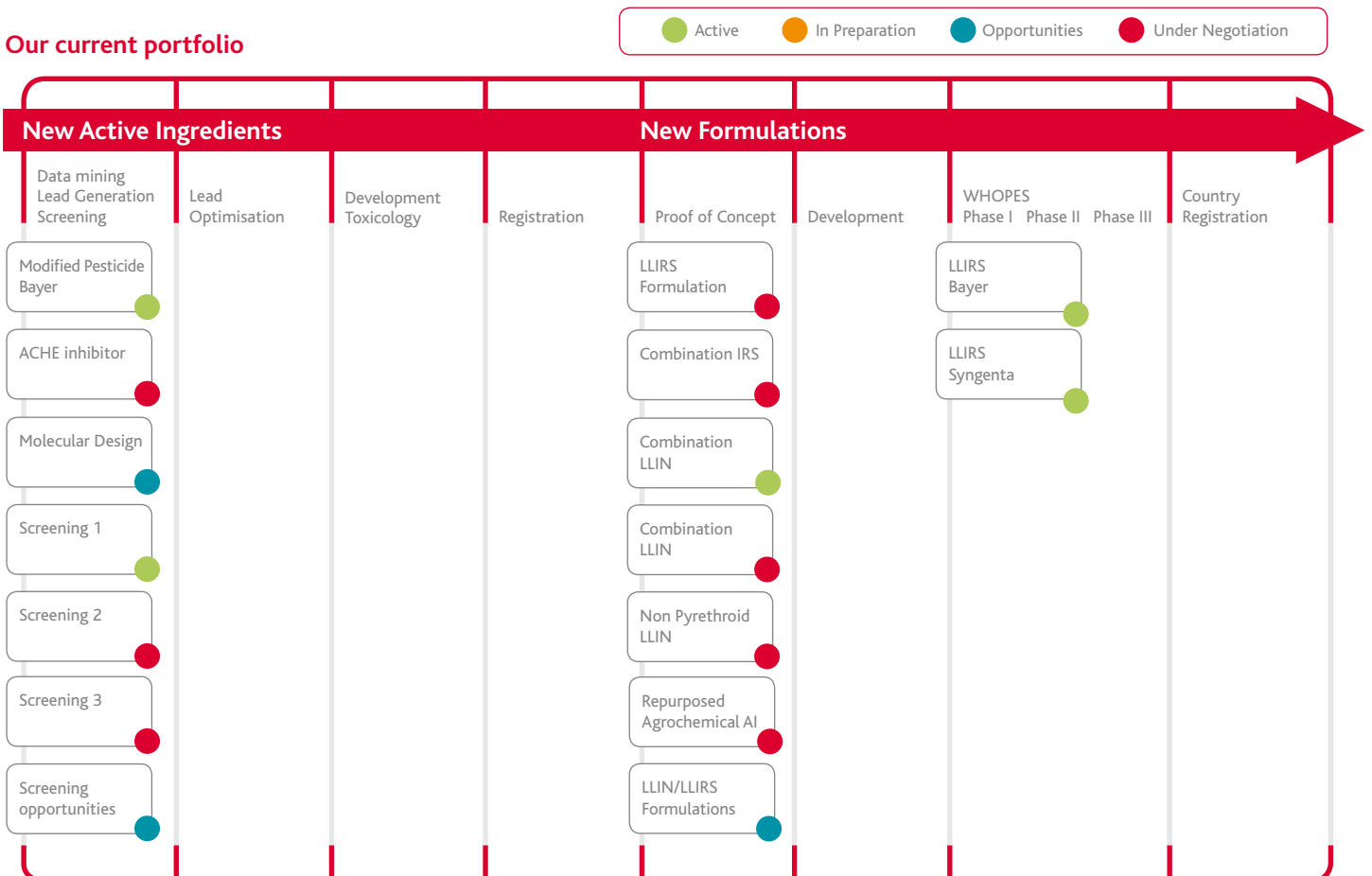
The insecticide research communities in both industry and academia are now actively collaborating, with IVCC sponsorship, to search for new AIs to control disease vectors and to overcome resistance:

- Three data mining and molecular library re-screening projects
- Two molecular design and synthesis projects

Early results in these projects are showing great promise in identification of resistance breaking molecules.

All of these insecticide projects are undertaken between the IVCC and commercial suppliers of PHPs who have the capability to take the developed products through to delivery. In every case the commercial partners have undertaken to supply the products developed in the partnership at an affordable price in the disease endemic countries.

Our current portfolio



How the IVCC operates

The IVCC is a Product Development Partnership developing vector control products and information systems. Bringing together expertise and technical resources with an initial award of \$50.7 million from the Bill & Melinda Gates Foundation, the IVCC is able to overcome the barriers that have blocked innovation in the development of vector control products.

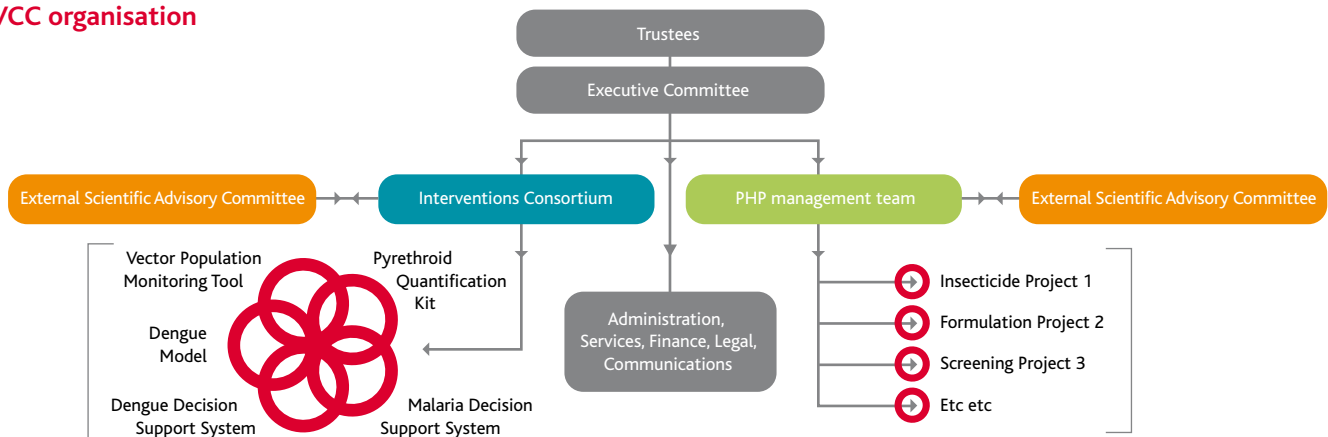
The IVCC is a not for profit company registered as a charity in the UK. The strategy and scope of the IVCC is directed by its Executive Committee under governance of the Board of Trustees who represent a wide range of expertise as well as other stakeholders in the field.

The portfolio of public health pesticides is managed by the PHP management team, using the portfolio management process of the chemical industry, with the key success criteria of potential impact on public health. To ensure access to the wide range of necessary

expertise we take advice from our Expert Scientific Advisory Committee (ESAC).

Projects in the field of information systems and tools are not commercially driven and are much more dependent on interproject communication. This group of projects is therefore managed in a consortium driven mode with the emphasis on communication and work-sharing rather than portfolio management. In this case the projects are approved by the initial grant giving body and managed by the IVCC rather than the stage gate approach of the PHP portfolio. The management style is focused on dissemination and technology transfer and a separate ESAC operates to ensure the implementation of best practice and optimal communication with external stakeholders. New projects in this field are established by applications to external funding bodies to expand support.

IVCC organisation



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