Piloting a new approach for capacity building in entomology and vector control at the level of national malaria control programmes

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More than ten years ago, there was a popular quote saying “the malaria eradication campaign succeeded in eradicating entomologists.” More than a quote, it gave a basis at that time to policy-makers and managers of national malaria control programmes to justify the limited vector control activities in their action plans, countries in southern Africa being the exception.

In 1999, the Vector Biology and Control Unit of the WHO Regional Office for Africa undertook a region-wide survey to identify existing medical entomologists in order to assess gaps in human resources within this particular area of expertise. This was undertaken with the anticipated needs of increased entomologists to support the then newly established Roll Back Malaria Initiative.

The resumes of 114 medical entomologists were collected from 35 countries throughout the region. Of this number, 37% were working for ministries of health, 52% were in research institutes or universities, 6% were working for the...
private sector and 5% were employed by international organization. WHO subsequently undertook to strengthen regional capacities in entomology and malaria vector control. This was to be achieved through three main strategies:

- Creating a professional network of experts;
- Facilitating communication between entomologists; and,
- Providing entomologists with opportunities to contribute to the development of national vector control activities.

As a result in December 2000, the African Network on Vector Resistance to Insecticides (ANVR) was founded by the WHO Regional Office for Africa. It had the following terms of reference:

- To assist WHO/AFRO Member States in the testing, monitoring and management of vector resistance to insecticides;
- To provide opportunities for medical entomologists in research institutions and universities and public health workers in vector control programmes to collaborate with a view to strengthening operational research and vector control;
- To assist Member States in capacity building for vector control and particularly in the training and supervision of nationals in the monitoring and management of insecticide resistance;
- To collaborate with all relevant institutions in order to standardize and harmonize methodologies, protocols and guidelines for analysis of data and interpretation of results;
- To build consensus on approaches to the management of insecticide resistant vector populations and to prepare practical guidelines for the management of vector resistance for use at national level; and
- To coordinate network activities and facilitate and promote the dissemination and exchange of information on vector resistance to insecticides.

After 13 years of existence, the ANVR has become one of the best organized and respected public health professional network of experts in the WHO African Region, with an established track record on mapping insecticide resistance, building capacity in vector control and undertaking research. Its work led to the publication by WHO in 2004 of the first atlas of insecticide resistance in malaria vectors in Africa. The atlas was updated in 2011, thanks to financial support from the Bill and Melinda Gates Foundation.

Despite important achievements at the international level, the ANVR and its national member institutions continued to have limited routine involvement with national malaria control programmes. A new approach in capacity strengthening for entomology and vector control was thus required.

A novel approach in capacity strengthening

In 2006 the ANVR conducted a rapid assessment of capacities in entomology and vector control at the level of ministries of health in African countries. In order to systematize the assessment, it was felt fundamental to clarify the minimum operating standards for effective vector surveillance by national malaria control programmes. A classification of capacities by levels and according to the technical requirements was agreed upon (see Table 1).

Based on this classification a rapid assessment was undertaken. The results are indicated in Table 2. This survey demonstrated that there was an important number of countries in Africa that did not meet the minimum required standards, i.e. lacked basic capacity for

Table 1. The three levels of vector surveillance activities and the required technical resources

<table>
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<th>Level</th>
<th>Corresponding activities</th>
<th>Required human resources</th>
<th>Required facilities and equipment</th>
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<tr>
<td>Basic</td>
<td>• Mosquito collection and preservation</td>
<td>Technologist: Diploma/BSc</td>
<td>• Aspirators, torches, light traps, rechargeable batteries, battery chargers, dippers, hand lenses, dissecting microscopes, silica gel, tubes, assorted entomology equipment</td>
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<td></td>
<td>• Morphological identification</td>
<td>Entomological assistants</td>
<td>• Identification keys, pinning kit, preservatives, storage boxes, desiccators</td>
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<tr>
<td></td>
<td>• Vector incrimination (sporozoite identification by microscopy and determination of infection rates)</td>
<td></td>
<td>• Dissection kits, dissecting and compound microscopes</td>
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<tr>
<td></td>
<td>• Vector susceptibility testing</td>
<td></td>
<td>• Susceptibility kits, treated papers</td>
</tr>
<tr>
<td></td>
<td>• Mapping and characterization of breeding sites</td>
<td></td>
<td>• GPS unit, dippers, collection trays, bottles, strainers, tape measures</td>
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<tr>
<td>Advanced</td>
<td>• Identification of operational research needs</td>
<td>Entomologists: MSc/PhDs</td>
<td>• Knowledge of vectors</td>
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<td></td>
<td>• Selection of sentinel sites</td>
<td>Technologists: Diploma/BSc/MSc</td>
<td>• Entomological and transmission data, maps</td>
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<td></td>
<td>• Analysis of data</td>
<td>Field assistants: Knowledge of statistics</td>
<td>• ELISA equipment</td>
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<tr>
<td></td>
<td>• Detection of sporozoites and source of blood meals by enzyme-linked immunosorbent assay (ELISA)</td>
<td></td>
<td>• WHO cones, treated papers</td>
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<td></td>
<td>• Insecticide bioassays</td>
<td></td>
<td>• Insectary</td>
</tr>
<tr>
<td></td>
<td>• Assessment of vector behaviour (biting, resting and host preferences)</td>
<td></td>
<td>• Mosquito sampling equipment</td>
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<tr>
<td>High</td>
<td>• Molecular identification of vector species</td>
<td>Entomologist/molecular biologist: MSc/PhDs</td>
<td>• Polymerase chain reaction (PCR)/ELISA equipment, imaging facility</td>
</tr>
<tr>
<td></td>
<td>• Biochemical and molecular assays for detection and determination of insecticide resistance mechanisms</td>
<td>Technologists: Diploma/BSc</td>
<td>• Insectary</td>
</tr>
<tr>
<td></td>
<td>• Operational research, e.g. vector behaviour (oviposition, swarming, dispersal)</td>
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In order to improve on this situation, the ANVR made the following recommendations:

a) Ministries of health should ensure that all national malaria control programmes have the basic capacity for malaria vector surveillance;

b) A formal process for collaboration between control programmes and research institutes within a specific country were to be established for the latter to provide advanced or high level services needed by the programmes; and

c) The ANVR was to continue to facilitate linkages between control programmes and research institutes across the region for continued harmonization, standardization and information sharing.

On the basis of these recommendations, WHO developed a project proposal for the Bill and Melinda Gates Foundation. The project was awarded in 2007. The project was entitled “Malaria Vector Control: Filling the Gap Between Product Development and Effective Delivery” and was constructed around five key elements:

- Ensuring basic vector surveillance capacities at the level of the national malaria control programmes;
- Identifying existing local research institute or laboratory with at least advanced capacity in vector surveillance;
- Establishing collaboration between the above two entities;
- Developing a decision support mechanism to help in the choice and combination of tools and interventions; and
- Sustaining a regional network for harmonization and coordination.

The key project objective was to strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management. A total of seven countries benefited from the project.

### Results

The project implementation was initiated in February 2008, with a needs assessment of national malaria control programmes and identified research institutes, in terms of funding, laboratory equipment and staff. All identified needs were catered for. Ministers of health decided to officially recognize the respective research institutes as national reference units (NRU) for entomology and vector control:

- Biotechnology Center of the University of Yaoundé I (Cameroon);
- Kenya Medical Research Institute;
- Institut Pasteur de Madagascar;
- Malaria Research and Training Center (Mal);
- National Institute of Health (Mozambique);
- Laboratoire d’Ecologie Vectorielle, Université Cheikh Anta Diop (Senegal); and
- National Institute of Medical Research (United Republic of Tanzania).

A collaborative agreement was established between the ministry of health and the respective institution to provide technical and scientific backup to national malaria control programmes in capacity building and laboratory support.

After four years, i.e. at the end of the project, and with effective support of NRUs, all national malaria control programmes of project countries were able to set up or strengthen their basic capacities in malaria entomology and vector control. These programmes are now able to carry out routine vector surveillance activities, using standard operating procedures developed by WHO.

The project enabled the training of 300 national entomologists at basic and advanced level in the seven project countries. The training focused on basic entomology and insecticide resistance monitoring. Among the trainees were 20 BSc, MSc and PhD students. In terms of capacity human resources at the level of national malaria control programmes,
the number of field entomology staff has increased. Cameroon trained a total of 60 field technicians from five provinces. Kenya trained 73 technicians and established teams consisting of two technicians, two mosquito collectors and one entomologist to conduct vector surveillance on the field. Madagascar has trained 13 technicians to carry out vector surveillance activities in six sentinel sites. In Mali a total of 18 technicians were trained in basic entomology at district level. In Mozambique six individuals underwent training in malaria entomology, sampling of malaria vectors, identification of malaria vectors, susceptibility testing and bioassay testing. In Senegal 91 technicians of hygiene and sanitation were trained in basic entomology and vector control techniques at district level. In the United Republic of Tanzania 39 field workers were also trained in basic entomology and insecticide resistance surveillance to implement surveillance activities in the 13 selected sentinel districts.

It has been observed that the demand for external technical support from the project countries has declined. In 2006 external technical support was sought by the seven project countries. In 2009 only two of them requested WHO support for vector control activities. And by the end of the project, in 2011, no requests for technical support for basic or routine vector control functions in malaria vector control were received by the WHO Regional Office from the project countries. However, the challenge remains to maintain the capacities developed to continue to ensure adequate support for the national malaria control programmes and the further strengthening of capacities.

Conclusion and lessons learnt

Ministries of health and particularly national malaria control programmes suffer from chronic shortage of human capacities. Malaria entomology is one of the most affected areas. The capacity strengthening approach piloted indicates that it is possible to harness existing local resources and expand the expertise base of control programmes, if an effort is made to provide an opportunity to research institutions to contribute to programme implementation, through nationally appropriate mechanisms. Other specialized technical areas in public health may use a similar approach to strengthen implementation and delivery capacities in public health.

References