

Forum

From the Laboratory to the Field: Updating Capacity Building in Medical Entomology

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Training and innovation in the field of medical entomology are essential to mitigate the burden of vector-borne diseases globally. However, there is a shortage of medical entomologists worldwide, and there are large discrepancies in capacity building in this field. In this article, we discuss the current situation, what is needed from the medical entomologist of today, and how we can bridge this gap.

Vector-borne diseases (VBDs) remain a heavy challenge to public health globally. Chikungunya and Zika have extended to the Western hemisphere, and Zika has become an international emergency [1]. Dengue outbreaks continue to affect most of the tropics in increasing numbers, and vaccine-preventable yellow fever caused recent epidemics in Angola, Democratic Republic of the Congo, and Brazilⁱ. The factors contributing to this global resurgence include anthropogenic changes, drug and insecticide resistance, global mobility, health system deficiencies, socioeconomic instability, and climatic events. Control of VBDs requires an effective and efficient integrated vector management (IVM), for which vector studies and medical entomology training are essential [2].

It is widely recognised that there is a shortage of younger, field-trained, medical entomologists (MEs), likely due to a generation gap in medical entomology (ME) training [3–6]. Although VBDs pose a greater toll on the public health systems of low- and middle-income countries, they are spreading globally, and, naturally, countries need to engage IVM in their health agendas.

Worldwide mapping of ME courses revealed that the large majority take place in the Americas (to the detriment of Africa), two thirds of the courses are taught in English, and mosquitoes are the most widely covered vectors. Further, the information on courses on VBDs and ME is scant or not accessible online [7]. There is a huge discrepancy between the needs related to the burden of VBD, and the offer of courses in countries most affected by VBD. The number of students graduated, or trained personnel hired into IVM programs, is insufficient, with poor geographical and language distribution, especially for African countries.

In February 2016, the centre for Global Health and Tropical Medicine of the Portuguese Institute of Hygiene and Tropical Medicine, supported by the Special Programme for Research and Training in Tropical Diseases, of the World Health Organization (WHO/TDR), organised a 2-day workshop in Lisbon, with representatives of 17 higher education institutions, with courses on ME and vectors of diseases (see Table S1 in the supplemental information online for a list of participants). The objectives of this meeting were to present the courses and to brainstorm about their format and contents. A discussion on the organization, management, and support of courses on vectors of diseases, concluded that the main challenges in this area are:

- (i) target/recruitment of student populations and career opportunities in ME;
- (ii) implementation issues, including costs and funding opportunities;

(iii) framework of the courses and possible benefits from exchange with other areas of entomology.

Most institutions use a CV-based system as a method for student recruitment. The target student population are academics at the undergraduate/postgraduate level, or technicians and physicians. In some circumstances, priority is given to applicants who are already working in the field in vector-control programmes. Therefore, the objectives of the attendees may vary from knowledge improvement, research implementation, to professional training or career requirements.

Ongoing courses are clearly not producing enough ME expertise, which may be linked to the lack of career opportunities in ME. Research in entomology, and ME in particular, suffers from a lack of funding fuelled by lower journal impact factors, as well as a bias towards research in vertebrate as opposed to invertebrate science [6]. Hence, students who intend to follow an academic or research-based career usually tend to opt for broader subjects to increase career stability, that is, ME is not the student's first choice either in terms of course or of career. In addition, there is a general lack of funding for vector-control programs in many countries, in particular in countries that are the most affected by these diseases, which is in contradiction to the worldwide burden of VBD. This results in a lack of infrastructure (vector, pathogen, and insecticide resistance surveillance, trained personnel, resources, public education, etc.), inducing a general lack of interest in vector control, jobs for the medical entomologist, and training. Furthermore, vector-control agencies have a less permanent or sustainable character, frequently perishing with the initial signs of control success, discontinuation of funding, or change in political priorities. VBD outbreaks should reinforce the demand for IVM programmes, but they are rarely accompanied by funding availability. Short

courses focused on control issues usually work on demand and are short lived, as pulses of funding that occur in response to an emergency are discontinued when the emergency disappears. Lack of sustainable investment is an issue, in particular for campaigns directed towards malaria control consolidation in Africa. Very likely, the general availability of courses in ME will remain scarce until prospective investment improves and is sustained.

Concerning the cost of the courses, some are state-funded by government agencies, and students are employees of health services or organizations working on vector control, either in a national or regional context. However, in other situations, courses are run by higher education institutions and their costs often exceed revenue from fees, representing an investment from the institutions. Hence, many ME courses were discontinued, aggravated by lack of student demand

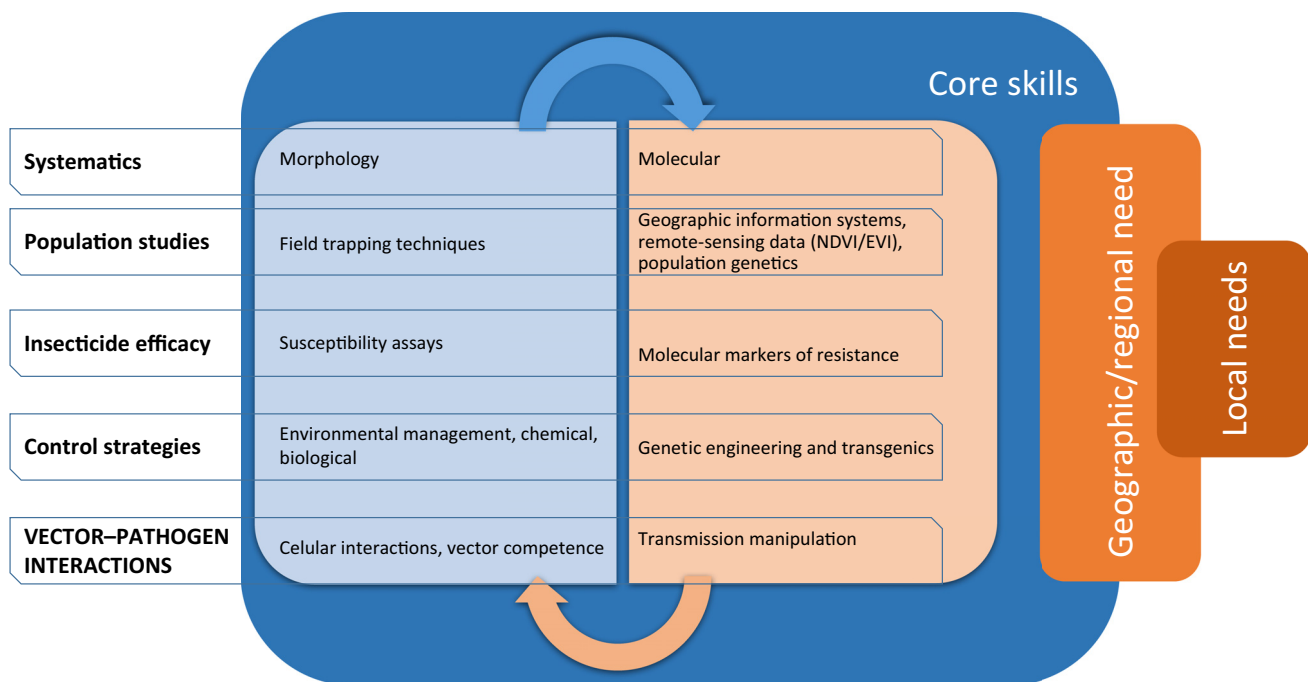
– as fees, student maintenance and mobility can only be met with grants or scholarships. Currently, entomology and ME departments are under-represented, as are degrees in this discipline, in many universities [5,6].

Lack of expertise at both basic-research and operational levels, scarce resources, and the reduced number of applicants puts pressure on implementing courses with a large-scope syllabus where entomology is a mere subject often out of context with the remaining curricula. Hence, full-scope medical entomology training is clearly missing worldwide. Furthermore, exchange with other areas of entomology, such as veterinary, forensic, or agricultural, could be highly beneficial.

What does a medical entomologist today need to know that is different from what was necessary 50 odd years ago? It has often been said that the teaching of ME has missed out on new technologies.

MEs today need to be in possession of classical skills and sound scientific knowledge, complemented by up-to-date technologies, constituting the focus of ME courses (Figure 1). The use of more sophisticated control strategies, including new methods of biological control in an IVM program (Figure 2), ‘takes more science, not less, to perfect and apply effectively’ [6]. Moreover, MEs of today have to deal with fast-growing human populations that surpass the capacity of municipal services to provide adequate sanitation, piped water, or vector-control services [8].

In order to attain effective capacity building of MEs, course priorities should be shifted onto: (i) greater diversification and integration of the various fields of vector biology research; (ii) transition from laboratory-based research to field studies of VBD ecosystems; (iii) understanding the heterogeneities of the various VBD systems, and accommodating for their



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Figure 1. The Medical Entomologist of Today. Skills and technologies that up-to-date medical entomologists (MEs) need to master and that should be offered by ME courses. The ideal ME course should focus on these subjects, by an intelligible and rational sequence, thus attaining the various desired competencies, followed by the appropriate specificities according to regional/local contexts.

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