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Editorial

An Introduction to Vector-Borne Diseases

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Editorial

Pathogens transmitted among animals, humans and plants by hematophagous arthropod vectors have been responsible for significant morbidity and mortality throughout human history. Together, Vector-Borne Diseases (VBDs) have accounted for more human disease and death during the last three centuries than all other causes combined [1]. Currently, the World Health Organization (WHO) estimates that one-sixth of the illness and disability suffered worldwide can be attributed to VBDs, with more than half of the world's population at risk. Every year, more than one billion people become infected and more than one million people die from VBDs, including African trypanosomiasis, American trypanosomiasis, dengue, leishmaniasis, malaria and schistosomiasis [2,3]. In addition, many VBDs, such as lymphatic filariasis and onchocerciasis, are able to cause significant illness and suffering, contributing to a much larger overall burden of disease that can be traduced in Disability-Adjusted Life Years (DALYs) [1,4].

VBDs are defined as infectious diseases of animals and humans caused by pathogenic agents such as bacteria, helminthes, protozoa and viruses transmitted by hematophagous arthropod vectors [5], which include bedbugs, biting midges, black flies, fleas, kissing bugs, lices, mites, mosquitoes, sand flies and ticks, among others [6]. From the hematophagous arthropod vectors, mosquitoes are the leading vector for human infectious agents, meanwhile ticks are the leading vector for the vast majority of zoonosis worldwide. Furthermore, ticks are the vectors responsible of transmitting the greatest variety of infectious agents to animals and humans [7].

BVDs are most frequently found in tropical and subtropical climates of many developing countries [8], and therefore, several of them are listed at the WHO's list of 18 Neglected Tropical Diseases (NTDs). NTDs can be characterized because they have subsisted in the poorest and most marginalized societies, where the lack of adequate sanitation, and close contact with infectious vectors and reservoirs prevail [9]. However, several newly identified pathogens and vectors have triggered disease outbreaks all around the world, and previously controlled VBDs have re-emerged in new geographic areas [1]. Bacterial infections like anaplasmosis, babesiosis, Carrion's disease, ehrlichiosis, Lyme disease, plague and tularemia, helminthic infections like opisthorchiasis and schistosomiasis, protozoan infections like African trypanosomiasis, American trypanosomiasis, leishmaniasis and malaria, and viral infections like those caused by African swine fever virus, bluetongue virus, Chandipura virus, chikungunya virus, Crimean-Congo hemorrhagic fever virus, dengue virus, equine encephalitis virus, Japanese encephalitis virus, sandfly fever Sicilian virus, sandfly fever Naples virus, Rift Valley fever virus, Ross River virus, sindbis virus, St Louis encephalitis virus, Tahyna virus, Toscana virus, Venezuelan equine encephalitis virus, West Nile virus and Yellow fever virus are some examples of them [7,10,11].

Effective vector transmission depends upon each component in the vector-borne system (pathogen, vector and reservoir). But it also depends on the interactions of these components within their environment, which can affect them directly or indirectly. Also their genotypes can influence successful transmission, as not just any pathogen can be transmitted by any vector and be hosted by any animal or human [7]. The dynamic balance that exists between them is strongly influenced by their ecology. Ecosystem changes influence the distribution and epidemic cycling of VBDs pathogens, resulting in unstable transmission and evolutionary settings. The most significant ecological changes with respect to infectious diseases emergence have been driven by human activities [10], such as climate change, deforestation of tropical forests, habitat fragmentation, biodiversity loss, animal movements, urbanization, agricultural practices, human population growth and migration [12]. The most worrying concern about these changed structural ecologies is increased contact rates between novel microorganisms, vectors and domestic host populations, resulting in secondary epidemiological cycles and disease. Climate change plays a key role in the emergence of VBDs, as the increased climate variability results in changing wet and dry climate cycles. In drought, vectors are usually suppressed as breeding sites dwindle, but where flood cycles follow this condition exacerbate vector emergence, especially where their life cycles are shorter than those of their predators. If these climate cycles are amplified, or become more or less frequent, they can alter the enzoonotic character of a region and may lead to the appearance of more epidemic diseases [10].

The complex epidemiology of VBDs creates significant challenges in the design and delivery of prevention and control strategies [13]. A thorough understanding of the disease ecology in each case is required. In particular, there is a need for a comprehensive understanding of the enzootic cycles, the pathogens and vectors involved, their reservoir hosts, and the drivers of transmission in the domestic landscape. Technical and therapeutically solutions exist to control and mitigate many VBDs, but it is the implementation of these solutions in a global context that has proven to be most challenging [10]. Consideration must be given to the capacity of public health systems worldwide to respond and adapt to the infectious diseases, and in particular to VBDs. In general, an effective public health response should include disease control strategies and methods to mitigate the effects of epidemics, and an optimally allocation of resources [8]. An example of this could be taken from the WHO's 2020 Roadmap on NTDs [14], a well-structured plan for control, elimination and eradication

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of at least 10 NTDs by 2020, and from the London Declaration on Neglected Tropical Diseases [15], a coordinated effort of endemic and non-endemic countries along with public and private parties to accelerate and enhance the response of the first mentioned.

Currently, on-host vector control with acaricides and insecticides remains to be the best evidence-based practice for preventing vector-borne infections in animals, meanwhile sleeping under insecticide-treated bed-nets, long-lasting insecticidal nets, and insect repellents to exposed skin, clothing, chemoprophylaxis and vaccination remains to be the best evidence-based practice for preventing vector-borne infections in humans [6]. However, the use of acaricides and insecticides is limited due to selection of resistant microorganisms; chemoprophylaxis is effective but for short periods of time; [5] vaccines production has been slowed due to the low economical incentive that these diseases pose to the pharmaceutical industry; and the ranks of scientists trained to conduct research in key fields including medical entomology, vector ecology and tropical medicine have dwindled, threatening prospects for addressing VBDs in the present and future [1]. Therefore, with the increased knowledge about mechanisms of transmission, pathophisiology and immune host response that have been obtained with years of research, the development of new and safer acaroids, insecticides, drugs and vaccines, associated with enhancing trainees and specialists on global health, and reinforcing the continuous medical education of general practitioners is urgently needed. Health professionals should expect an increase in the incidence of BVDs, as well as their appearance on previous unreported areas. Clinicians should be prepared to ask for epidemiological background, to recognize initial clinical manifestations in order to rise a high index of suspicion, to order relevant studies that will aid in diagnosis, and to offer prompt treatment to reduce the pain and suffering of those whom may be affected by them.

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