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Approaches to mosquitoes prevention and control

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Short Communication

Several species of mosquitoes (Diptera: Culicidae) including *Aedes*, *Culex* and *Anopheles* genera are vectors of pathogens responsible for zoonoses of considerable medical-veterinary incidence (Goddard, 2008; Tabbabi and Bekhti, 2017a,b,c). Females, through a meal of blood on a vertebrate host, are able to contract and carry three types of infectious agents including viruses responsible for many arboviroses (dengue, chikungunya, fever West Nile, Rift Valley fever, or yellow fever), protozoa of the genus *Plasmodium* responsible for malaria, and nematodes responsible for filariasis (especially lymphatic filariasis and heartworm disease) (Goddard, 2008; Mullen and Durden, 2009). Currently, a change in the geographical distribution of these vectors mainly caused by anthropogenic factors is accompanied by (re) emergence of infectious diseases, particularly in Europe and North America (Reiter, 2001; Jones *et al.*, 2008; Gould and Higgs, 2009; Randolph and Rogers, 2010; Medlock *et al.*, 2012; Bonizzoni *et al.*, 2013). Social, demographic and environmental factors have altered patterns of pathogen transmission that have resulted in intensification, geographic spread, re-emergence or prolongation of seasonal transmission. Many factors including unplanned urbanization, lack of a reliable network of water supply channels, and inadequate management of solid wastes and excreta can expose large urban populations to the risk of viral diseases spread by mosquitoes. Increased travel and trade worldwide, combined with environmental factors, such as changes in land-use patterns (eg deforestation) and climate change, may also have an impact. Together, these factors affect vector populations and patterns of transmission of pathogens causing disease.

Historically, vector control has been an essential component of public health management. At present, taking into account global changes (climatic, demographic and socio-economic) and the need for sustainable development is a new challenge (McMichael *et al.*, 2006). To meet these expectations, the fight against vector must today use various techniques. As in the agricultural and forestry fields, an integrated pest management concept is now required. The dynamics and complex nature of vector-borne pathogens complicate predictions of the impact of existing, re-emerging, or novel diseases on human health. Despite this unpredictability, it is reasonable to expect the emergence of new vector-borne diseases and the intensification of certain existing pathologies, particularly viral diseases transmitted by *Aedes* mosquitoes closely associated with urbanization. Pathogens that may be transmitted by *Culex* mosquitoes and other arthropods are also of concern. This complexity and unpredictability underscore the imperative need for adaptive and sustainable approaches to prevent and reduce pathogen transmission in order to reduce the burden of disease (Tabbabi *et al.*, 2017). Targeting vectors that transmit disease-causing pathogens is an effective preventive approach against most vector-borne diseases. Interventions to reduce human-vector contact and vector survival can prevent or even stop transmission. In the past, it has been found that rigorous vector control can result in significant reductions in the disease burden.

As we know, mosquitoes will continue to poison our lives, because they bite us and especially because they spread diseases. By feeding on human blood necessary for their reproduction, these tiny insects can inoculate us with one blood meal, one or more pathogens. On the medical side, the research undertaken has led to the development of a vaccine against dengue marketed for several months by Sanofi-Pasteur. The one against chikungunya, developed in particular by the Pasteur Institute, has been in the clinical trials phase since 2014 after more than ten years of research following the outbreak of the island of Reunion (Tabbabi, 2018). As for Zika, the joint epidemics currently under way in 23 countries in South and Central America as well as in the Caribbean with brain complications in infants are unleashing the activism of international multidisciplinary teams (Tabbabi, 2017). However, it will take several years to develop an effective vaccine. While waiting for medical scientific research to succeed, there are other angles of attack. If the antidotes to viruses are not yet ready, the fight against their vectors, the mosquitoes themselves is one of the solutions to guard against them. It is repeated all the time, so as not to have to suffer an epidemic of dengue, Zika or chikungunya, it is enough to protect oneself from the mosquitoes (by cutaneous repellents), and to do everything to avoid becoming passive breeders of these insects in our homes. It is up to everyone to clean their doors and hunt mosquito houses. If the mechanical vector control by systematic destruction of mosquito breeding is not followed by all, it remains ineffective. Once again, however, scientific research comes to the rescue of this global public health problem. Beyond chemical and non-chemical spraying, whether they are insecticides (to kill adult mosquitoes) or larvicides (to kill larvae before they have been transformed into flying insects), other more radical and ambitious solutions are being carried out in different countries (Wahlon *et al.*, 2008). In other countries, particularly in Brazil, campaigns for the release of male sterile mosquitoes have been initiated but have not yet demonstrated the complete effectiveness of this experiment launched by the British company.

Health systems must be ready to detect changes and act quickly and effectively. This action requires not only the availability of proven and effective control interventions, but also well-trained government-level staff that can put in place sustainable systems to deliver these interventions. To achieve these goals, there is an urgent need to reform the programmatic structures for vector control. The problem of vector-borne diseases concerns everyone, not just the health sector. Achievement of sustainable development to ensure good health and well-being will depend on effective vector control, as well as initiatives for clean water and sanitation (Goal Utzinger *et al.*, 2002), cities and sustainable communities and measures to combat climate change, among others. Several approaches that are being implemented by different sectors such as the promotion of a healthy environment will be needed to combat and eliminate vector-borne diseases (Pruss *et al.*, 2017). Involve local authorities and communities in intersectoral collaboration . This will be essential for improving vector control interventions, adapting them to specific scenarios defined by local entomological and epidemiological data. Establishing sustainable control programs that are robust to technical, operational and financial challenges will require the engagement and collaboration of local communities. Recent progress in modernizing and developing new vector control and surveillance tools is an excellent opportunity to strengthen vector control. For it to be effective, strong political commitment and long-term investments are needed. This action does not seek to replace or cancel existing and effective disease-specific strategies, or to divert attention to other essential interventions, such as yellow fever vaccination, Japanese encephalitis, mass drug administration for lymphatic filariasis, or artemisinin-based combination therapies for malaria. On the contrary, it tends to add to these efforts and to help countries put in place coherent and coordinated interventions to reduce the burden of disease and the increasing threat of vector-borne diseases.

Vector control interventions offer one of the best returns on public health investment (Vasquez *et al.*, 2009). Effective vector control programs that reduce disease can advance human and economic development. Apart from the direct health benefits, reducing vector-borne diseases will result in increased productivity and growth, reduced household poverty, greater equity and empowerment of women, and increased health systems. The optimal impact of enhanced vector control is based on quality implementation that requires appropriate deployment, coverage, adoption and use of the recommended activities. The impact of vector control on the environment and biodiversity is an important consideration as many vector-borne diseases are part of complex ecological systems; unintended effects on non-target organisms should be avoided.

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