Review

In relation to Epidemiologic and Entomologic Surveillance of Zika Virus

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Similarly to Dengue and Chikungunya, Zika virus requires a comprehensive response involving several areas of action, from health, to education and the environment, whose joint activities allow to substantially reduce vector populations. The purpose of this article is to present a combination of two strategies for controlling the *Aedes aegypti* vector, responsible for transmitting Zika virus. This combination of practices will allow the integration of epidemiological and entomological surveillance that usually act separately. It is based on systematic and order control activities primarily through the importance of the "Weekly Epidemiological Report" by recipients and key sites index for monitoring and control of vector. By reporting the information generated through technical training to the inhabitants of houses by the vector control personnel who act against reported cases. This knowledge is transmitted to each inhabitant of the home; trained to identify recipients and key sites, producing a multiplier effect on the population. In this sense, the population will know what actions should take timely and permanently at home for mosquito control and inform properly the decision-making level. The procedure consists of five steps: (1) characterize the locality where the cases are generated (2) inspection of the dwelling by the staff of vector control program (3) technical training to the inhabitants of the housing (4) information to the unit of epidemiology and entomology and weekly report generation (5) implementation in the community, tracking and monitoring of cases. These steps are established from the practical experience of previous work and by reference to other models and practices of different countries. Finally, note that for making a succesful intervention, demonstrated as health improvements for the population, it is necesary an active and ongoing participation of the community and of all personnel involved in control activities.

Keywords: knowledge, containers, key sites, epidemiological surveillance, entomological, Zika virus

INTRODUCTION

The Zika virus (ZIKV) is a viral disease transmitted by mosquitoes of the genus Aedes, in rural and urban areas (OMS, 2015). *Aedes aegypti* and *Aedes albopictus* have been implicated in large outbreaks of Zika virus. Also, other species of this genus as *Aedes hensilli*, *Aedes* polynesiensis, *Aedes furcifer*, *Aedes taylori* and *Aedes* luteocephalus (Fernández-Cortez, 2013). *Ae. aegypti*, the yellow fever mosquito is the primary vector of yellow fever epidemic virus (YFV), dengue virus (DENV), chikungunya (CHIKV), and Zika virus (ZV). Zika virus is characterized by mild fever, a rash (mainly maculopapular), headache, joint pain, muscle pain,

malaise and non purulent conjunctivitis that occur within three to twelve days after the bite of mosquito vector (OMS, OPS, 2015).

Due to high infestation of *Ae. aegypti* and the presence of *Ae. albopictus* in the Region, it is recommended that prevention and control measures are aimed at reducing vector density, with the acceptance and cooperation of the local population in the adoption of such measures (OMS, 2015). In this regard, the Pan American Health Organization and the World Health Organization (PAHO / WHO) calls to update the recommendations relating to monitoring, strengthening previous recommendations on the same vector-borne diseases and urges to Member States in which circulates the Aedes mosquito to continue its efforts to implement an effective communication strategy with the population to reduce the density of the vector.

In this regard, the entomological and epidemiological surveillance is a fundamental aspect for controlling the *Ae. aegypti*. However, it is now observed that most epidemiological and entomological surveillance systems are separated, vertical structures, which even work located in different departments of the Ministry of Health in most countries (LLoyd, 2003). Another important aspect is the lack of communication between departments. Epidemiological reports are sent, often by mail to the vector control department, causing a delay of one to three weeks since generation of the case (LLoyd, 2003). This situation is associated with the fact that during outbreak situation and / or epidemics this number increases considerably, resulting in delays in control actions, coupled with the failure of human resources that usually suffers the vector control program.

With this situation, each of the monitoring systems is first saturated by the failure of the registration of all case reports (sub-registers) and the difficulty that every time a home is inspected does not allow the official to perform the recommendations to correct the people, by the time factor, since the control in housing should be performed in an approximate radius of 200 meters (Crespo et al., 2003) where the case has been reported. Moreover, this weakness usually accompanied to the shortage of staff in the group that don't allow the inspection of all the houses that should be treated, check potential recipients and record formats, even less to properly train their inhabitants.

Vector control is achieved primarily by removing containers that are suitable habitats for oviposition and allowing the development of aquatic stages of vector. It is called "key containers" to particular deposits that often produce very high amounts of mosquitoes (Phong and Nam, 1997). *Ae. aegypti* breeds and develops in these containers of water and its life is closely associated with

human activities. Therefore, the most effective method to control vector is through reduction of "key receptacles" which goal it to eliminate the mosquito larvae, their habitats in and around homes, where most of disease transmission occurs (MPS, 2010). Similarly, the "Key sites" are the places under surveillance for the prevention and control of dengue (LLoyd, 2003).

Infestation index for housing in the provinces of Ecuador, which presented historical high levels, including the provinces of: Manabi, Guayas, El Oro, Esmeraldas y los Rios (MSP, 2015). In general, all populations most densely inhabited of the country are more vulnerable to major epidemics of dengue, Chikungunya and Zika virus, but in Guayaquil presents a special problem: in the city, four serotypes of the dengue virus are circulating, and also chikungunya virus has spread, so there is a high proportion of vulnerable population and vector infestation rates are high (OPS/OMS, 2007). This situation results in overcrowding of services and expenses of public health system due to the inability to control and reduce sources and index rates in dwellings; also conditioning as in dengue cases to progressively decrease the proportion of the working population on which rests the economic growth of country. From there, the importance of preserving and maintaining a system of epidemiological and entomological surveillance, integrated with the community to provide results that will substantially reduce the larval population of the vector, which will influence not only in reducing transmission of Zika virus but also in chikungunya and dengue fever, because these viruses share a common vector (Fernández-Cortez, 2013).

Regarding the situation in Ecuador, lot of economic resources have been prepared for several years to reduce morbidity by dengue cases (Viteri, 2007); efforts are aimed, among other objectives, to obtain biological information of *Ae. aegypti* mosquito, including climatic, geographic and socio-economic factors to deploy with Geographical Information Systems in order to develop an early warning system for vector control, but the community does not participate. On the other hand, there are few measures dedicated to the maintained prevention throughout the year (recognized as the most effective), so it would be desirable to have another strategy to guide the personnel in charge of vector control not only in epidemics situations and outbreaks as it occurs regularly, but also permanently, in which the whole community make part of it (Viteri, 2007).

Considering the above, the purpose of this paper is to propose a strategy for the reduction of larval density of *Ae. aegypti* by entomological and epidemiological surveillance, integrated with the community with a previous training. The steps to allow this are described orderly by suggesting the tools used in each case.

PROCEDURE FOR LARVAL DENSITY REDUCTION OF *Ae. aegypti*.

Step 1. Characterize localities where cases are generated

It must be identified the province, county, city, neighborhood, community and street where cases are being generated. Appoint two members of the program to attend local problems and diagnose risk factors that facilitate the presence of the vector in communities (Strickman and Pattamaporn, 2003; Barrera et al., 1995). This diagnosis should be made as far as possible in conjunction with the entomologist assigned to the vector control program. The search for this information can be done passively (morbidity records, environmental variables (geographic coordinates of temperature, humidity, primarily) water bodies, vegetation, direct observation of containers and mosquito outbreaks among others) and actively (conversations with key community personnel, survey application) (Barrera et al., 1995). Once identified the risk involved in the town, proceed to second step.

Step 2. Inspection of dwellings by the vector control program staff

The basic input to ensure a timely and adequate entomological surveillance is the entomological information. This should follow a process of collection, tabulation, systematization, analysis and interpretation for decision making that contribute to efficient and effective control vector of *Ae. aegypti*. This step could support the historical revision of infestation index for housing and deposits over the last five years and the result of interventions in the past before going to the sector. Identify the registry location and streets that started generating cases even when resources and time are limited. It is convenient to prioritize the areas of greatest risk (key sites).

After reviewing the streets and houses where most cases are being generated, it is important to inspect housing (key containers) starting from the rear of house (MPS, 2008). As the activity of home inspection goes by, at this time training begins to household members who are present. In this regard, it should focus on improvement of dynamic aspects of bio-ecology of the vector and key containers. Similarly, the use of physical treatment such as flutter, washing and brushing technique casks are recommended. This activity ranges from 20-30 min. Similarly, once the training is finished, risk evaluation groups can be set, preferably voluntarily among other actions (Armada and Trigo, 1981; UNICEF, 2009). As a result of the evaluation, it is determined

if there is risk at present time or have been permanently and proposals are made to improve this situation. In the absence of risk, it is necessary to look for other causes that may determine above identified problems.

Step 3. Technical training for the inhabitants of dwellings. Intervention proposals

The purpose of this step is to minimize or eliminate exposure to risk factors and key containers with the training and technical assistance of inspectors assigned by the program and the community. This training is basically the recognition of the key containers, identify larval stage, make the respective annotations in the registration form that usually uses the vector control program or design and adapt a survey itself and eliminate breeding or key containers. Main sources of potential solutions can be found with the inhabitants of the houses that supervise the work of the other teams that are formed in toguether with the community. It is needed the intervention of the entomologist assigned to the program and other specialists where similar experiences or practices similar tasks are executed.

The vector control Program of the World Health Organization (Parks and Lloyd, 2004) establishes interventions classified into three groups: 1) engineering groups, aimed at reducing exposure to physical risks; 2) administrative, focused on changing the way it is organized and designed the work and 3) behavior (or personal), focused on the behavior and capabilities of workers. In this step, proposals suggested by each working group are evaluated and the best is adopted. It is very important at this stage an accurate evaluation of all the proposals, allowing to select the most convenient according to the considered variables, which obviously change depending on the context. The evaluation results should be presented in an attractive and understandable language to decision makers; point out the advantages and disadvantages of each proposal and include their respective cost / benefit analysis. An effective way is the creation of multidisciplinary teams, as each participant brings their approach and deep knowledge of the community, thereby achieving a more comprehensive analysis. This activity at the discretion of the author is essential to consolidate the proposals in practice.

Prototypes of such interventions constitute the removal of covers cars that represent an excellent breeding for its form (it is impossible to remove the water dump), material (insulation) and dark color (captures infrared energy) that maintains suitable temperatures for mosquito development. Large containers (typically 200 liters) and laundry sinks (when disused and covered with leaves) are very good breeding sites for its ability to maintain large amounts of larvae (Armada and Trigo, 1981).

Step 4. Information on the Epidemiology Unit and weekly report generation

It is necessary to have the support of at least two community residents permanently involved in locating and monitoring of containers and key sites. This person will notify the representative or official of the vector control program of the cases on a weekly basis. This subject will inform to the officer of both epidemiological and entomological surveillance. From this information is generated the weekly epidemiological report discriminated from the corresponding level (prioritized population) (MSDS, 2003). Both surveillance units should be analyzed, emerged from the community or the group, if it solves the problem partially or completely or if the Ministry of Health is capable of assuming the implementation and whether the cost / benefit ratio is favorable. Program indicators must be reviewed if these have been effective in reducing cases and if compared with other practices in the past on sites identified as endemic, have shown a significant impact on the population (Armada and Trigo, 1981). Unfortunately, professionals dedicated to this area and related research, are generally limited in achieving this crucial task, as, operating costs, logistics, human resources and community participation and tools necessary to carry out the actions, are not always included in the budget for the vector control program.

Step 5. Implementation and monitoring community

The objective of this step is to inspect implemented proposals and test their efficiency. During execution is recommended for greater acceptance of inhabitants because the continuity of actions and self-care of their health depends on them. While adapting proccess is being developed, community actors have to be monitored and trained (Ministerio de Salud, 2009). It is important to keep all who are part of this strategy, informed and convinced that the new proposals will not return to the old practices (Secretaría de Salud, 2007). Probably, desired effects are not achieved on the first try, but if it is permanent and sustainable over the time, new cases will not be noticed. This proposal is subject to continuous improvement of activities.

FINAL CONSIDERATIONS

During many occasions, Provincial Health Directions perform isolated and uncoordinated actions in control interventions, mostly without proper ongoing monitoring of the program. The present method can serve as a reference to those responsible for this field, since it provides step activities to be carried out in an orderly manner and with a systemic approach for success in vector control intervention. The importance of each phase is mentioned to those responsible for resource allocation, as all efforts would be useless if all proposals for improvements for vector control are not emphasized. Finally, note that for a successful intervention which is manifested in the reduction of morbidity from this cause it is necessary the active participation of all personnel involved in the activities discussed.

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