Opinion article

No magic bullet: citizenship and social participation in the control of *Aedes aegypti*

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We were already used to our every summer dengue. A seasonal epidemic that has happened in a relatively predictable repeated manner, since the late 1980s. A condition that is closely related to the seasonality of its urban, domestic, anthropophilic and synanthropic vector.

Due to the absence of effective and large-scale vaccines, and to the lack of a specific treatment against dengue symptoms, the general guideline is to focus on the reduction of the vector density. This was the routine of service managers and health agents.

Most of *Aedes aegypti* breeding sites are located inside households, and in the past years this knowledge initially contributed to place the responsibility on the population. The discussion that followed – "who's the guilty?" – deviated the focus from key issues: sanitation, access to piped water, waste collection, mobilization, disease prevention and health promotion, citizenship etc. The debate has evolved and nowadays the participation of society, in a collective effort, is stimulated.

Everything seemed to go as planned; our problems were being handled (despite sweeping some under the carpet) and nothing was beyond the usual discomfort we were used to manage so far.

Then, a sanitary earthquake takes place in the country, with several shock waves: first, the imminent arrival of chikungunya virus, with an alarming possibility of long-term health compromise of patients;[1] the second was a smooth wave, the emergence of the Zika virus, apparently a disease with mild and short-lived symptoms;[2] the third wave of this sanitary earthquake came with microcephaly in babies, Guillain-Barre syndrome in adults, and also other potential neurological damages. Panic takes over. It mobilizes the population, media, and service managers, reaching other countries and leading to the recognition by the World Health Organization (WHO) that Brazil is passing through an international public health emergency.[3,4]

The world's attention turns to Brazil. The pressure here is felt individually and collectively, inside and outside the academy and the health services environment. People try to create individual solutions to protect themselves and repellents disappear from the shops' shelves; magic recipes for protection and control against the mosquito vector multiply on social networks, and, besides that, charges against the possible culprits, in the best "conspiracy theories" style, arise. After all, it seems that everyone understands a bit about communication and vector control. A significant part of the media, opinion multiplier, engages in mobilizing the society to participate in preventive actions; researchers are called to collaborate and many questions come up.

Some scientists are quick to bring solutions to control the vector, either with already known technologies or with "innovative" or "alternative" approaches. Biomedical solutions include since returning to the emphasis on using insecticides by the method of ultra-low volume (ULV, also known as 'fogging' in many parts of the country) to releasing sterile mosquitoes (produced by genetic modification or by irradiation),[5,6] as attempts to reduce the vector populations. The "Wolbachia-based strategy", a sustainable technology that replaces the populations of *Aedes aegypti* by individuals that are not able to transmit the virus, is also at hand.[7] In other knowledge fields, initiatives that are inspired by the attention given by

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human and social sciences to communities, citizenship and the environment begin to gain relevance, reflecting the maturity of the country in recognizing that diseases transmitted by vectors transcend the sphere of Health Care and require intersectoral actions.[8,9]

In this context, the International Meeting for Implementation of New Alternatives for *Aedes aegypti* Control was held in February 2016 in Brazil under the coordination of the National Program for Dengue Control (*PNCD*), a program that belongs to the Ministry of Health. At that meeting, technologies with the potential to be implemented in the affected cities were evaluated, considering the structural and operational issues of vector control in the country.[10] At that time, some of the methodologies were considered and distributed into the three categories presented below.

1) Recommended approaches for immediate inclusion in *PNCD*

In this category three initiatives were included. All of them have been previously tested in some Brazilian municipalities with satisfactory results and were considered viable to be incorporated into the country's control actions without a significant impact on the program costs or routine:

- The strategy known as eco-bio-social, which focuses on social participation and environmental management in controlling the vector.[11] This approach significantly reduced the vector density in Fortaleza, Ceará State, and is already being applied in two other municipalities, as requested by the Ministry of Health: Goiânia, Goiás State, and Belo Horizonte, Minas Gerais State.
- The risk mapping takes into consideration the spatial heterogeneity in the distribution of infections. This methodology uses relatively simple methods to identify areas that persistently accumulate dengue cases. The proposal, in this context, is to enhance the interventions in those areas.[12,13]
- The spread of larvicide mediated by the mosquitoes themselves, which act as disseminators.[14] The strategy is based on the fact that *A. aegypti* females spread their eggs in many breeding sites, reaching breeding spots that are inaccessible to men, especially in urban environments which are disorganized and are in a vulnerable situation. Mosquito mediated pyriproxyfen dispersion, the larvicide currently used by the *PNCD*, was conducted in the Amazon region by previously trained endemic control agents. A reduction of the vector density of at least ten times was verified.[15]

2) Recommended approaches for inclusion in *PNCD* in special situations

In this category, actions aiming the protection of pregnant women, considered a priority group on the epidemic of Zika virus, were listed. For this group, the recommendation was to include in the routine of the Program the use of window and door screens, with or without insecticides, to keep the mosquitoes away, the distribution of repellents for personal protection and the possibility of intradomiciliar insecticide spraying. However, the impact of these measures on the budget of Brazilian cities, even if applied only to this particular group of people, is an issue that cannot be overlooked. Restricting public resources to be used primarily on protecting public places, such as health facilities and schools, is a possibility to be considered.

3) Potentially promising technologies

This category included strategies that cannot be incorporated immediately in the *PNCD* either because their cost is incompatible with the available public resources, or because the schedule for national-level implementation is not feasible in the short-term, or even because they add important operational issues, such as a deep change in the routine of health agents – which requires time and planning. Wolbachia-infected mosquitoes, sterile mosquitoes and the application of spatial repellents for homes were added here.

Sterile males aim to reduce vector populations. Their sterilization is achieved genetically (transgenic mosquitoes) or through irradiation.[5,6] Females inseminated by sterile males do not generate a viable offspring. Nevertheless, this approach requires a frequent release of massive amounts of sterile males in order to become powerful against vector populations. This is especially relevant in the case of irradiated specimens, who have their survival and viability jeopardized by the process.

The idea behind Wolbachia-infected mosquitoes is different: these mosquitoes are intended to have a dual function, both reducing and replacing the original populations. The presence of these bacteria, precludes or impairs mosquito infection with the dengue and chikungunya virus.[16] There is evidence

that it also happens with Zika virus[17]. The introduction of Wolbachia in *A. aegypti* does not involve genetic engineering. This strategy has a sustainability component missing from the sterile males' technology: Wolbachia-infected females produce more offspring than wild females. Since all eggs derived from those females are already born containing Wolbachia, there is no need for frequent releases of mosquitoes. Besides, wild females inseminated by Wolbachia-infected males cannot produce offspring, causing a reduction in the original population.[18]

There is also a strategy that combines Wolbachia-infected males and irradiation. By using this procedure, already performed with *Aedes albopictus,* it is not necessary, before releasing females in the field, to separate them from males in the laboratory – one of the most expensive stages of the technique. In this case, the sterilization of males happens due to the presence of Wolbachia and the irradiation is used to sterilize females of this lineage. Because these females are more susceptible to radiation, there is little compromise in the viability of males.[19]

It is worth noting that, for both Wolbachia-infected mosquitoes and sterile mosquitoes, the local population partnership is an essential factor. Both methods require strong engagement of communities, since they are based on the release of mosquitoes, a task that is the opposite to the common sense of vector control. This situation reveals an additional evidence of the complexity of this issue and shows that, even if the solution was merely technological, the biomedical technology could not dispense other technologies neither the theoretical-methodological framework typical of human and social sciences, especially information, education and communication.[9]

In addition, a question remains: what is the risk of moving away from the central problem if we give priority essentially to the technical and welfare aspects of vector control? Appropriate medicines are only possible when the diagnostic is correct. Experiences from other countries, and even from some places and situations in Brazil, show that the relation among different government sectors, added to the participation of non-government sectors and the general civil society, are at the basis of a successful control of dengue epidemics.[9] Yet, the question remains: how to support it?

This overwhelming epidemic of Zika virus is an extreme situation, with no precedents, certainly the biggest health emergency in which all living Brazilians have been through. The population is insecure, and this can lead to panic. In whatever perspective we look at, this is a unique opportunity to rethink our assumptions. From an essentially mercantilist point of view, this situation can be an excellent business opportunity. For some academic sectors, it can constitute a great opportunity to gain visibility and curriculum prestige. But it can also be an opportunity for each person to assume his social responsibility and leave his comfort zone, both individually and collectively.

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