INTEGRATIVE LITERATURE REVIEW ARTICLE

COPING WITH AEDES AEGYPTI IN THE BRAZILIAN CONTEXT*

ENFRENTAMENTO AO AEDES AEGYPTI NO CONTEXTO BRASILEIRO

ENFRENTANDO AL AEDES AEGYPTI EN EL CONTEXTO BRASILEÑO

Diane Sales Vieira¹ , Ítala Keane Rodrigues Dias² , Cicera Luciana da Silva Sobreira³ , Francisco Elizaudo de Brito Junior⁴ , Maria do Socorro Vieira Lopes⁵

ABSTRACT

Objective: to synthesize the actions developed to confront *Aedes aegypti* in the Brazilian context. **Method:** this is a bibliographic, descriptive, integrative review study. The search was performed at MEDLINE, LILACS and BDNF. The filters were used: full text available; language (Portuguese, English and Spanish), type of document (article) and year of publication (2013-2018). The process of definition and selection of studies was organized through the PRISMA flowchart. IRAMUTEQ software was used for data processing and analysis. Data was analyzed from Descending Hierarchical Classification and word cloud. **Results:** 31 studies were selected. Six classes originated with the following strategies: entomo-pathogenic fungi; larval fish; *Wolbachia pipientis*; RILD and SIT techniques; botanical insecticides; larvicides Diflubenzuron and Deltramine; Pyriproxyfen; technological monitoring; regular visits by ACS and ACE; eco-health approach; MIV and campaigns. **Conclusion:** it is concluded that there are a variety of strategies for coping with arboviruses and how much the improvement and development of innovative techniques for the control of this disease are necessary. **Descriptors:** Aedes; Mosquito Control; Brazil; Disease Prevention; Arbovirus Infections; Infection Control.

RESUMO

Objetivo: sintetizar as ações desenvolvidas para o enfrentamento ao *Aedes aegypti* no contexto brasileiro. **Método:** trata-se de um estudo bibliográfico, descritivo, tipo revisão integrativa. Realizou-se a busca na MEDLINE, LILACS e BDNF. Utilizaram-se os filtros: texto completo disponível; idioma (português, inglês e espanhol), tipo de documento (artigo) e ano de publicação (2013-2018). Organizou-se o processo de definição e seleção dos estudos por meio do fluxograma PRISMA. Utilizou-se o *software* IRAMUTEQ para o processamento e a análise dos dados. Analisaram-se os dados a partir da Classificação Hierárquica Descendente e da nuvem de palavras. **Resultados:** selecionaram-se 31 estudos. Originaram-se seis classes com as seguintes estratégias: fungos entomopatogênicos; peixes larvívoros; *Wolbachia pipientis*; técnicas RILD e SIT; inseticidas botânicos; larvicidas Diflubenzuron e Deltramina; Piriproxifeno; monitoramento tecnológico; visitas regulares pelo ACS e ACE; abordagem ecossáude; MIV e campanhas. **Conclusão:** conclui-se que há uma variedade de estratégias de enfrentamento às arboviroses e o quão são necessários o aperfeiçoamento e o desenvolvimento de técnicas inovadoras para o controle deste agravo. **Descritores:** Aedes; Controle de Mosquitos; Brasil; Prevenção de Doenças; Infecções por Arbovírus; Controle de Infecções.

RESUMEN

Objetivo: sintetizar las acciones desarrolladas para enfrentar al *Aedes aegypti* en el contexto brasileño. **Método:** este es un estudio bibliográfico, descriptivo, tipo revisión integradora. La búsqueda se realizó en MEDLINE, LILACS y BDNF. Se utilizaron los filtros: texto completo disponible; idioma (portugués, inglés y español), tipo de documento (artículo) y año de publicación (2013-2018). El proceso de definición y selección de estudios se organizó a través del diagrama de flujo PRISMA. El *software* IRAMUTEQ se utilizó para el procesamiento y análisis de datos. Los datos se analizaron a partir de Clasificación Jerárquica Descendente y nube de palabras. **Resultados:** se seleccionaron 31 estudios. Seis clases se originaron con las siguientes estrategias: hongos entomopatógenos; peces larvales; *Wolbachia pipientis*; Técnicas RILD y SIT; insecticidas botánicos; larvicidas Diflubenzuron y Deltramine; Piriproxifeno; monitoreo tecnológico; visitas regulares de ACS y ACE; enfoque de ecosalud; MIV y campañas. **Conclusión:** se concluye que hay una variedad de estrategias para hacer frente a los arbovirus y cuánto es necesaria la mejora y el desarrollo de técnicas innovadoras para el control de esta enfermedad. **Descriptor:** Aedes; Control de Mosquitos; Brasil; Prevención de Enfermedades; Infecciones por Arbovirus; Control de Infecciones.

^{1,3,4,5}Cariri Regional University/URCA. Crato (CE), Brazil. ¹ <https://orcid.org/0000-0003-3228-0791> ³ <https://orcid.org/0000-0003-2380-9606> ⁴ <https://orcid.org/0000-0002-3585-8467> ⁵ <https://orcid.org/0000-0003-1335-5487> ²Federal Institute of Ceará/IFCE. Tauá (CE), Brazil. ² <https://orcid.org/0000-0003-3027-825X>

*Article extracted from monograph << Coping with *Aedes aegypti* in the Brazilian context >>. Cariri Regional University, 2018.

How to cite this article

Vieira DS, Dias IKR, Sobreira CLS, Brito Junior FE de, Lopes MSV. Coping with *Aedes aegypti* in the Brazilian context. J Nurs UFPE on line. 2019;13:e241722 DOI: <https://doi.org/10.5205/1981-8963.2019.241722>

INTRODUCTION

It is understood that arboviruses transmitted by the mosquito *Aedes aegypti*, dengue, zika and chikungunya have had negative impacts on public health, resulting in human suffering and massive socioeconomic losses worldwide, especially in tropical countries such as Brazil, given the environmental conditions favorable to vector proliferation. Between 2000 and 2007, an annual cost in the Americas of about \$ 2.1 billion was reported for dengue alone.¹

Arboviruses are known to range from febrile, undifferentiated, moderate or severe disease with rash, chronic arthralgia, and may progress to severe cases from hemorrhagic syndromes to congenital syndromes with irreversible neurological complications.²⁻³

It was stated that the interventions performed to intervene in these health problems are seen, in some aspects, as difficult to implement because it transcends the health sector with the need to perform intersectoral actions. Thus, it is sought that the Unified Health System (UHS) provides the states and municipalities with better conditions for the proper handling of this situation.⁴

It should be noted that one of the strategies developed to fight dengue was the development of a vaccine, Dengvaxia or CYD-TDV, produced by Sanofi Pasteur. This vaccine was licensed in 2015 and 19 countries accepted it, including Brazil. However, it is revealed that it is only available in the state of Paraná. Strategies for further development of a Zika vaccine are being studied through further research, but are still at an early stage of development.⁵

In addition, the use of insecticides for the elimination of mosquitoes has been a widely used practice in recent years, as it has immediate action, but recent studies have shown the development of resistance in mosquitoes, especially *Aedes aegypti*, due to the process known as “evolutionary adaptation”, making it more difficult to cope.⁶

When glimpsing the impacts of arboviruses at the world and national levels, along with the limitations of some prevention strategies, it can be seen how important the actions of the three spheres of government face in view of the great challenge of vector control and the complexity of the factors that cause the expansion of arboviruses in the country.⁷

Continued development of strategies for coping with arboviruses is needed, as well as the strengthening and refinement of techniques already in place, in order to rethink more effective and effective coping strategies for this ancient and, at the same time, current problem of public health.⁸

The following guiding question is pointed out: “What actions against *Aedes aegypti* developed in the Brazilian context have been reported in the scientific literature?”

It is noteworthy that this research assumes remarkable relevance due to its contributions to the field of health care, from the sharing of information regarding the activities developed in the various realities, focused on coping with arboviruses, and significantly contributing to the planning of public management.

OBJECTIVE

- To synthesize the actions developed to confront *Aedes aegypti* in the Brazilian context.

METHOD

This is a bibliographic, descriptive, integrative review (IR) study,⁹ in six stages: first - establishment of the research question; second - establishment of sampling and literature search; third - categorization of studies; fourth - study evaluation; fifth - interpretation of the results; sixth - synthesis of knowledge and presentation of results.⁹

It was defined as a research question: “What are the actions to combat *Aedes aegypti* developed in the Brazilian context have been reported in the scientific literature?”.

The study was conducted in August 2018 from the following sources: Medical Literature Analyzes and Retrieval System Oline (MEDLINE); Latin American Literature on Health Sciences (LILACS) and the Nursing Database (BDENF). The advanced search method was used, which allowed linking the descriptors to refine the search and categorization by title, abstract and subject.

The descriptors were defined: *Aedes*; Mosquito Control; Brazil; Prevention of diseases; Arbovirus Infections; Infection Control. Descriptors were used in all data sources by crossing with the boolean operator AND.

Two crosses were performed with the aforementioned Boolean operator as search strategy: *Aedes* AND Mosquito control AND Brazil AND Disease Prevention; Brazil AND Arbovirus infections AND Infection control.

The search filters used were: five-year scope; language (Portuguese, English and Spanish); document type (article) and full text available. The titles and abstracts of the studies were read, with subsequent analysis, according to the inclusion criteria: original research that answered the research question. Studies that were not developed in the Brazilian context, repeated studies and those that did not answer the research question were excluded.

Studies regarding the level of evidence were classified as: Level I - studies from systematic review or meta-analysis; Level II - randomized controlled studies; Level III - Evidence from quasi-experimental studies; Level IV - evidence from descriptive (non-experimental) or qualitative studies; Level V - evidence from case or experience reports; Level VI - Evidence Based on Expert Opinion.¹⁰

Included are original studies, with level of evidence IV, which constitute qualitative or descriptive studies.

Thirty-one studies were selected after applying the inclusion and exclusion criteria to be fully analyzed. It was organized and presented the process of definition and selection of articles

through the flowchart Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA),¹¹ as shown in Figure 1.

The data was submitted for processing and analysis in the software IRAMUTEQ (R interface for Multidimensional Analysis of Textes and Questionnaires), which is a computer program with the function of performing statistical analysis on textual corpus and tables of individuals by words.¹²⁻¹³

In addition, the textual corpus of this review consisted of the abstracts of the 31 previously selected studies, which were placed in a single text file in LibreOffice, version 5.4, as recommended.

Figure 1. Study selection flowchart adapted from the Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRISMA 2009). Crato (EC), Brazil, 2018.

Two methods were used for the analysis of the studies: the word cloud, in which words are grouped and organized graphically according to their frequency, and the Descending Hierarchical Classification (DHC), in which texts are classified according to their respective vocabularies and their set is divided by the frequency of the

reduced forms.¹² The software analysis results were presented in a dendrogram.

RESULTS

A total of 1,094 records were identified on the researched theme. After applying the filters, 415

records were tracked. At the end of reading the titles and abstracts of the 415 publications, 31 studies for full reading were selected, all of which were included in the integrative review.

From the word cloud, in the first data analysis, the most frequent keywords were obtained: control; *Aedes aegypti*; mosquitoes; dengue; wolbachia and pipientis, as shown in Figure 2.

Figure 2. Word cloud. Crato (EC), Brazil, 2018.

The Descending Hierarchical Classification (DHC) performed from IRAMUTEQ's corpus processing was analyzed. The following results were obtained: Initial Context Units (ICU) or number of texts - 31; Elementary Context Units (ECU) or number of text segments - 234; number of forms - 2,259; number of occurrences - 8,504; average frequency of forms - 36,341,880; number

of clusters - six; retention of text segments - 196 classified segments out of 234, equivalent to 83.76% of use for analysis. Six classes were registered in the DHC, presented in a dendrogram, in which they sought to identify and interpret their textual domains, naming them as shown in Figure 3.

Figure 3. Dendrogram of Descending Hierarchical Classification. Crato (EC), Brazil, 2018.

It was named class 1, “Use of biological control as a strategy for coping with *Aedes aegypti*”,

consisting of six studies, with 34 ECUs out of 196, equivalent to 17.4% of the textual corpus, directly

related to the classes 3 and 4. The most frequent and expressive words of these text segments were observed: case; pathogens; public; America; zika; virus; serious; DENV; Chikv; chikungunya; species; dengue; transmit and zika, both with $p < 0.0001$.

This class includes studies that present approaches to biological control through the use of entomo-pathogenic fungi; the impact on the environment due to the release of mosquitoes carrying the bacterium *Wolbachia pipientis*; the release into the environment of sterile mosquitoes by the Sterile Insect Technique (SIT) and the use of botanical insecticides to control the *Aedes aegypti* vector.

It was named class 2, “Social participation and performance of the FHS in facing *Aedes aegypti*”, with a total of seven studies, presenting in 45 ECUs, of 196, equivalent to 23% of the textual corpus, and this class is the least related to the others. The most frequent and expressive words of these segments were presented: health; Social; activity; FHS; cost; community; County; action; student and agent, both with $p < 0.0001$.

It is noteworthy that this class favored mechanical control over chemical control. Actions involving the community and the FHS are mentioned: conducting community workshops addressing *Aedes* control; cleaning campaigns; distribution of education and information materials to the community; establishment of partnerships; intersectoral meetings; selective waste collection; regular visits by the community health agent (CHA) and vector control professionals, keeping the population informed about prevention measures, identifying mosquito outbreaks and larvicide application.

Class 3, “Technological monitoring of the *Aedes aegypti* mosquito outbreaks” was designated, consisting of four studies, equivalent to 12.24% of the textual corpus. It points to the most frequent and expressive words of these segments: population; technology; City; introduction; monitoring; system and egg, both with $p < 0.0001$. It is evident that studies in this class address innovative themes, such as the technology monitoring system and mosquito population control, Integrated Vector Management (IVM), as well as techniques already used as the release of individuals with *Wolbachia pipientis* and the application of insecticides by heavy equipment.

It was named class 4, “Using *Wolbachia pipientis* to control *Aedes aegypti*”, consisting of five studies, with 27 ECUs out of 196, equivalent to 13.8% of the textual corpus. It is revealed that the most frequent and expressive words of these text segments were: *pipientis*; *wolbachia*; infected; infection; high; larval; to affect; bacterium; streaming; density; substitute; blood; parameter; incompatibility; cytoplasmic and ADM, both with $p < 0.0001$. All studies in this class refer to the use of *Wolbachia pipientis* as an excellent method for vector control.

Class 5, “Release of genetically modified mosquitoes”, was formed from three studies, presenting in 30 ECUs out of 196, equivalent to 15.31% of the textual corpus. It is directly related to class 1. The most frequent and expressive words are: insect; release; sterile; male; dominant; lethal; genetically; strain; carrier; technique; program; OX513A; released; dispersal; environment; eliminate and create, both with $p < 0.0001$. It is noteworthy that studies of this class bring in common the use of techniques such as the release of insects carrying the dominant lethal gene and the release of genetically sterile *Aedes aegypti*, which prevent larvae from developing.

Class 6, “Use of larvicides and larvivorous fish as a control strategy for *Aedes aegypti*”, was constructed based on six studies, with 36 ECUs out of 196, equivalent to 18.4% of the textual corpus, directly related to class 5. The most frequent words were observed: larva; concentration; fish; Water; pyriproxyfen; larvicide; temephós; juvenile; xiphophorus; maculatus; larvivore; to integrate; mortality; dissemination; drain; emergency; use; adult and effect, both with $p < 0.0001$. Studies of this class bring approaches of joint interventions, such as the use of larvivorous fish associated with the use of Pyriproxyfen, a pesticide used in cotton plantations that was also used in vector control.

All studies used in the integrative review and their respective classes were organized in a table, according to the IRAMUTEC analysis, as shown in Figure 4.

Author	Year	Class	Base/Journal
Porto, Motti, Machado, Roel ¹⁴	2016	01	LILACS/Brazilian Society of Tropical Medicine Journal
Wang, Zhao, Oliva, Zhu ¹⁵	2017	01	PUBMED/ <i>Scientific reports</i>
Reis, Silva, Reis, Silva, Reis ¹⁶	2017	01	PUBMED/ <i>The Brazilian Journal of Infectious Diseases</i>
Evans, Elliot, Barreto ¹⁷	2018	01	PUBMED/ Oswaldo Cruz Institute Memories
Gomes, Tavares, Beyruth, Palermo, Santos ¹⁸	2015	01	PUBMED/ <i>Parasites & vectors</i>
Carolino, Gomes, Teodoro, Samuels ¹⁹	2017	01	LILACS/ Univap Journal
Alecrim, Cotta, Castro ⁷	2016	02	LILACS/ <i>Journal of Health Sciences</i>
Cazola, Tamaki, Pontes, Andrade ²⁰	2014	02	LILACS/Public Health Journal
Caprara, Lima, Peixoto, Motta, Nobre, Sommerfeld et al. ²¹	2015	02	PUBMED/ <i>Transactions of the Royal Society of Tropical Medicine and Hygiene</i>
Alfonso-Sierra, Basso, Beltrán-Ayala, Mitchell-Foster, Quintero, Cortés et al. ²²	2016	02	PUBMED/ <i>Pathogens and global health</i>
Freitas, Valle ²³	2014	02	PUBMED/ <i>Bulletin of the World Health Organization</i>
Sarmiento, Miguita, Almeida, Gaban, Silva, Souza et al. ²⁴	2016	02	PUBMED/ Oswaldo Cruz Institute Memories
Salvador-Neto, Gomes, Soares, Machado, Samuels, Fonseca et al. ²⁵	2016	02	PUBMED/Mar Drugs
Gesto, Araki, Caragata, Oliveira, Martins, Bruno et al. ²⁶	2018	03	PUBMED/ <i>Parasites & vectors</i>
Lima-Neto, Nascimento, Souza ²⁷	2016	03	LILACS/Braz. journ. Heath. Prom
Regis, Acioli, Silveira, Santos, Souza, Ribeiro et al. ²⁸	2013	03	MEDLINE/ <i>PLoS One</i>
Piovezan, Acorinthe, Visocks, Azevedo, Von Zuben ²⁹	2017	03	PUBMED/ <i>Bulletin of entomological research</i>
Caragata, Dutra, Moreira ³⁰	2016	04	PUBMED/ <i>Microbial cell</i>
Dutra, Rodrigues, Mansur, Caragata, Moreira ³¹	2017	04	MEDLINE/ <i>Scientific reports</i>
Dutra, Silva, Fernandes, Logullo, Freitas, Moreira ³²	2016	04	PUBMED/ <i>Parasites & vectors</i>
Dutra, Rocha, Dias, Mansur, Caragata, Moreira ³³	2016	04	PUBMED/ <i>Cell host & microbe</i>
Dutra, Santos, Caragata, Silva, Vilela, Maciel-de-Freitas et al. ³⁴	2015	04	PUBMED/ <i>PLoS neglected tropical diseases</i>
Winskill, Carvalho, Capurro, Alphey, Donnelly, McKemey ³⁵	2015	05	PUBMED/ <i>PLoS neglected tropical diseases</i>
Andrade,Aragão, Colli, Dellagosin, Finardi-Filho, Hirata et al. ³⁶	2016	05	PUBMED/ <i>Bulletin of the World Health Organization</i>
Carvalho Nimmo, Naish, McKemey, Gray, Wilke et al. ³⁷	2014	05	PUBMED/ <i>Journal of visualized experiments: JoVE</i>
Paiva, Lima, Camelo, Lima, Cavalcanti ³⁸	2014	06	PUBMED/ <i>Tropical Medicine & International Health</i>
Abad-Franch, Zamora-Perea, Luz ³⁹	2017	06	PUBMED/ <i>PLoS medicine</i>
Caixeta, Silva, Santos, Campos Júnior, Pereira ⁴⁰	2016	06	PUBMED/ <i>Journal of Toxicology and Environmental Health</i>
Pereira, Caixeta, Freitas, Santos, Limongi, Campos Júnior et al. ⁴¹	2016	06	PUBMED/ <i>Journal of Toxicology and Environmental Health</i>
Souza, Mugabe, Paploski, Rodrigues, Moreira, Nascimento et al. ⁴²	2017	06	PUBMED/ <i>Parasites & vectors</i>
Chediak, Pimenta, Coelho, Braga, Lima, Cavalcante et al. ⁴³	2016	06	MEDLINE/ Oswaldo Cruz Institute Memories

Figure 4. Results found in studies according to author, year of publication, class and journals. Crato (EC), Brazil, 2018.

DISCUSSION

It is recalled that all classes elaborated by the IRAMUTEQ software are related to the strategies used to fight the *Aedes aegypti* mosquito in Brazil, however, the first class is less specific.

It was observed that all the results obtained in the integrative review point to the use of various types of actions developed in the fight against *Aedes*, which are: use of the endosymbionte

bacteria *Wolbachia pipiens*, larval fish, transgenic mosquitoes; use of larvicides and insecticides and eco-biosocial approach.

It is noteworthy that, similarly to this study, an analysis made in Brasília presented similar results, with the identification of ten strategies developed worldwide, namely: *Wolbachia*; transgenic mosquitoes; pyriproxyfen dissemination stations, Israeli *Bacillus thuringiensis*, pyriproxyfen,

spinosade, space repellent, Temephós; eco-biosocial approach and lethal ovitrap.⁴⁴

In addition, another study conducted in Goiânia-Goiás pointed out other strategies not evidenced in this study, besides presenting them separating them into isolated and combined techniques. They were presented in the isolated techniques: ecobiosocial approach; natural compounds or essential oils of plants; Wolbachia; insecticide spreading mosquitoes; residual intradomiciliary space nebulization; insecticide devices; transgenic mosquitoes; insect sterilization by irradiation. The following techniques were identified: Wolbachia and SIT by irradiation; insecticide-impregnated clothing and insecticide-impregnated fabrics.⁴

It is revealed that class 1, "Use of biological control as a strategy for coping with *Aedes aegypti*", although it does not clearly show, in the words presented, which strategies used to cope with the mosquito, points to actions aimed at biological control, as the use of entomopathogenic fungi and bacteria *Wolbachia pipientis*. It is pointed to the use of fungi as an innovative technique. In a study conducted in São João da Barra, Santa Catarina, the reduction in the number of eggs found in *Aedes aegypti* from the use of fungi was evidenced.⁴⁵

It is pointed out that, in class 2, with 23% of success, the most used strategies in coping with the vector in Brazil are evidenced, constituting the social participation and performance of the Family Health Strategy (FHS) in coping with *Aedes aegypti*. The importance of the development of collective actions involving the whole population, together with health agencies and other entities, through intersectoral actions is emphasized. The activities that involve coping with *Aedes aegypti* are shown to be related to a set of actions related to Primary Health Care (PHC), health surveillance, health education and social participation.⁴⁴

It is noteworthy that the FHS is inserted in the first level of actions and services of the UHS, therefore, constitutes an essential element in the prevention and control of arboviruses, because, through this, it is possible to perform awareness activities and information dissemination about the disease, including control measures.⁴⁶

Two key actors in this process involving the FHS stand out: the community health agent (CHA) and the endemic control agent (CHA). It is believed that through home visits, these professionals are able to perceive irregularities or lifestyle habits that endanger the health of residents, including inadvertent exposure of containers that can store water without proper protection.

It is reported that a study conducted in the state of Goiás, Brazil, showed that health education activities approximate the management

of the population, breaking with the traditional vertical relationship existing between health professionals and the population. It was also evidenced in this study that health education promotes the empowerment of the population, making them aware that they are mainly responsible for their health care.⁴

It is pointed out, however, that educational campaigns alone are unsuccessful if the population is not deeply aware of the importance of promoting health and collective well-being.⁴⁸ It is mentioned that the educational actions, in most cases, are limited to lectures, being strongly practiced in certain periods of the year, assuming a campaign character,⁴⁹ not achieving satisfactory results.⁵⁰ Therefore, horizontal health education actions are needed, strengthening the relationship between users and professionals.⁴⁴

In class 3, technological monitoring is evidenced as an important means of coping with mosquito outbreaks. It is a method of Dengue Vector Population Monitoring and Control System (SMCP-*Aedes*), which continuously collects eggs with georeferenced ovitraps and semi-automatic egg counting by the Computer Assisted Counting System (CACS). The collected data are sent to the Geographic Database and then maps of the risk areas that can guide control actions.⁵⁰

It is noteworthy that a research carried out in 15 villages of the oceanic island of Fernando de Noronha, aiming to discover the spatial and temporal distribution of *Aedes aegypti* in this territory, also made use of SMCP - *Aedes*, which was easy to handle, with true results that could help in understanding the dynamics and diffusion of arboviruses.⁵¹

It is mentioned that, IMV, proposed by the World Health Organization (WHO), is also present in this class. It is the optimization of resources through a rational decision-making process based on the availability of human and structural resources, reinforcing the importance of social participation.

Another action used to combat *Aedes aegypti*, pointed out by IRAMUTEC, in class 4, was the use of *Wolbachia pipientis*, a gram-negative endosymbiotic bacterium. Its use is linked to the fact that it causes changes in host biology, such as: feminization; parthenogenesis; cytoplasmic incompatibility and male death. *Wolbachia* also inhibits additional human mosquito-borne pathogens.⁵²

It is noteworthy that studies conducted in Australia revealed suppression of DENV replication and *Aedes aegypti* dissemination by up to 70%,⁵³ however, measuring the precise epidemiological impact of *Wolbachia* implantation to reduce the transmission of some viruses is still a challenge,

and the lack of infrastructure for mass breeding of *Wolbachia pipientis* infected mosquitoes⁵⁴.

Class 5 includes the use of genetically modified mosquitoes: Insect Release Technique Carrying Dominant Lethal Gene, also known as the Release of Insect carrying a Dominant Lethal gene (RIDL), and the Sterile Insect Technique (SIT), being the first most used. It is believed that this RILD technique has advantages over other genetic modification techniques because it makes insects more sexually competitive in nature. It is explained that insects can be released at any stage of development as they do not cause environmental damage or generate high costs. The RILD technique is said to be far more effective than SIT due to male copulation performance.⁵⁵

It is emphasized that SIT is the artificial sterilization of mosquitoes and subsequent release to the environment; In this case, male mosquitoes will be mass-raised in captivity where they will undergo a radiation process that will cause their sterility. It is noteworthy that, as a consequence, the mosquito will be unable to reproduce, causing the decrease in its population. Some factors that limit the success of this technique are pointed out, such as competitiveness for reduced copulation.⁵⁶

According to Oxitec, pilot projects conducted in Brazil, Panama and the Cayman Islands in 2010 measured the effects of the release of these genetically modified mosquitoes among local populations. The results revealed a reduction of up to 80% of the population of *Aedes aegypti* in the test sites.

In class 6, the use of insecticides, larvicides and larvivorous fish as control strategies is noteworthy, and chemicals such as insecticides are the most used means due to their immediate action. It is currently pointed out that several insecticides are being used in this control or are in the experimental phase. It is noted that one of the studies in this class deals with the use of insecticides formulated from cashew nut bark and ricinoleic acid from the *Ricinus communis* plant, popularly known as castor bean.¹⁴

It was noticed during the study analysis that one of the identified larvicides is the Temephós-based organophosphate, which acts on the inhibition of the enzyme acetylcholinesterase. It is noteworthy that studies indicate the development of resistance against Temephós and that it is currently little used. A study in the municipalities of Maracaju and Naviraí, in the state of Mato Grosso do Sul, showed that the populations of *Aedes aegypti* have a well-established resistance, since the average mortality rate was below 80%.⁵⁷

Other larvicides were detected during the analysis of the studies, Diflubenzuron and Deltamethrin, both used as a government strategy

to eliminate household outbreaks through visits by trained professionals. Diflubenzuron is believed to be a potent inhibitor of chitin synthesis, causing insect death as a result of cuticle malformation.⁵⁸

Another strategy is emphasized in a research developed in the city of Manacapuru, State of Amazonas: the use of mosquitoes capable of spreading Pyriproxyfen, a larvicide that interferes with the development of mosquitoes, causing female sterilization. Results show an increase in mosquito mortality of 80-90%.³⁹

However, it was observed that a research carried out in Madeira Island, using the same strategy mentioned above, did not obtain such satisfactory results, since there was no considerable reduction in the number of *Aedes aegypti* females, however, there was a reduction in the number of eggs laid in the ovitraps.⁵⁹

It has been identified that the use of entomopathogenic fungus *Metarhizium anisopliae*, in association with neem oil, is capable of infecting from the egg to the adult phase of the mosquito. It has been shown that oil formulations can improve the efficiency of entomo-pathogenic fungi. It was shown in a research that the blastopores of this fungus increases the mortality rate of up to 90% of *Aedes*.¹⁹

It is noticed that the strategy of using fish in water reservoirs is widespread in Brazil. In some studies included in the review, fish species that are used for this practice were mentioned: *Betta splendens*; *Trichogaster trichopterus*; *Xiphophorus maculatus* and *Poecilia reticulata*, being effective in eliminating mosquito larvae. It is noteworthy that, in addition to its ease of use, such practice does not cause harm to human health and is economically positive.⁶⁰

When placed in an environment where, in addition to the existence of larvae, there is a greater amount of other substrates, fish choose to feed on these substrates instead of *Aedes* larvae³⁴.

From the results, it was observed that the use of strategies for the control of arboviruses requires a continuous assessment of their effectiveness, as it is necessary that they are safe, have timely results, do not negatively impact the environment, and are sustainable and present reasonable costs for their execution.

This research was limited by the occurrence of some studies, which did not show their results in the abstract, considering that the textual corpus was constituted only by the abstract.

CONCLUSION

It is concluded that the strategies for coping with arboviruses implemented in Brazil, according to the scientific literature, are: use of entomopathogenic fungi, larvivorous fish, *Wolbachia pipientis*, RILD and SIT techniques, botanical

insecticides, Diflubenzuron and Deltramine Piriproxifeno larvicides; technological monitoring; regular visits by CHA and CEA; eco-health approach; IVM and campaigns to mobilize communities.

It is noteworthy that, in class 2, strategies involving actions performed by health units together with the population are evidenced, that is, actions of a social character, which are the most widespread and used in Brazil because they are more effective and promising compared to actions that occur in isolation without the participation of society.

It is evident how important it is for society to be the main actor in actions to combat mosquitoes, in view of its strong influence on the environment in which it finds itself, continuously monitoring and eliminating vector outbreaks and significantly contributing to the prevention of diseases.

Based on this study, the most used strategies for coping with *Aedes aegypti* in Brazil were determined. It is confirmed that the development of new techniques that address the weaknesses of the strategies hitherto used is necessary.

From the strategic planning point of view, it is recommended to develop review studies, focused on the analysis of strategies individually, weighing positive and negative points, in order to contribute significantly to the improvement or development of new strategies for integration, with different mechanisms for controlling and preventing *Aedes aegypti* mosquito-borne diseases.

REFERENCES

1. Murray NE, Quam MB, Wilder-Smith A. Epidemiology of dengue: past, present and future perspectives. Clin Epidemiol. 2013 Aug;5:299-309. DOI: [10.2147/CLEP.S34440.eCollection2013](https://doi.org/10.2147/CLEP.S34440.eCollection2013)
2. Lopes N, Nozawa C, Linhares REC. General features and epidemiology of emerging arboviruses in Brazil. Rev Pan-Amazônica de Saúde. 2014 Sept;5:55-64. DOI: [10.5123/S2176-62232014000300007](https://doi.org/10.5123/S2176-62232014000300007)
3. Pustiglione M. Occupational Medicine and emerging, reemerging and neglected diseases: the conduct in the case of dengue, Chikungunya and Zika virus. Rev Bras Med Trab [Internet]. 2016 Dec [cited 2018 Aug 10];14(1):01-12. Available from: <http://rbmt.org.br/export-pdf/1/v14n1a01.pdf>
4. Zara ALSA, Santos SM, Fernandes-Oliveira ES, Carvalho RG, Coelho GE. *Aedes aegypti* control strategies: a review. Epidemiol Serv Saúde. 2016 Apr/June; 25(2):391-404. DOI: [10.5123/S1679-49742016000200017](https://doi.org/10.5123/S1679-49742016000200017)
5. World Health Organization. Dengue and severe dengue [Internet]. Geneva: WHO; 2018 [cited 2018 Aug 15]. Available from: <https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue>
6. Valle D, Belinato TA, Martins A J. Controle químico de *Aedes aegypti*, resistência a inseticidas e alternativas. In: Valle D, Pimenta DN, Cunha RV. Dengue: teorias e práticas. Rio de Janeiro. Fiocruz; 2015. p. 94-126.
7. Valle D, Belinato TA, Martins AJ. Controle químico de *Aedes aegypti*, resistência a inseticidas e alternativas. In: Valle D, Pimenta DN, Cunha RV, editors. Dengue: teorias e práticas. Rio de Janeiro: Fiocruz; 2015. p. 93-126.
8. Alecrim JS, Cotta A, Castro JM. Relationship between the actions for the dengue fever prevention and the impact caused on the cases reported between 2009 and 2010. J Health Sci [Internet]. 2017 Sept/Dec [cited 2018 Aug 15];18:286-90. Available from: <https://revista.pgskroton.com/index.php/JHealthSci/article/view/3834/0>
9. Maniero VC, Santos MO, Ribeiro RL, Oliveira PAC, Silva TB, Moleri AB, et al. Dengue, chikungunya e zika vírus no brasil: situação epidemiológica, aspectos clínicos e medidas preventivas. Almanaque Multidisciplinar de Pesquisa [Internet]. 2016 [cited 2018 Aug 15];1(1). Available from: <http://publicacoes.unigranrio.edu.br/index.php/amp/article/view/3409>
10. Mendes KS, Silveira RCCP, Galvão CM. Integrative literature review: a research method to incorporate evidence in health care and nursing. Texto contexto-enferm. 2008 Oct/Dec;17:758-64. DOI: [10.1590/S0104-07072008000400018](https://doi.org/10.1590/S0104-07072008000400018)
11. Souza MT, Silva MD, Carvalho R. Integrative review: what is it? How to do it?. Einstein [Internet]. 2010 Jan/Mar;8(1):102-6. DOI: [10.1590/s1679-45082010rw1134](https://doi.org/10.1590/s1679-45082010rw1134)
12. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC, Devereaux MC, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. PLoS medicine. 2009 July;6(7):e1000100. DOI: [10.1371/journal.pmed.1000100](https://doi.org/10.1371/journal.pmed.1000100)
13. Camargo BV, Justo AM. IRAMUTEQ: a free software for analysis of textual data. Temas em psicologia. 2013 Dec;21(2):513-8. DOI: [10.9788/TP2013.2-16](https://doi.org/10.9788/TP2013.2-16)
14. Moura LKB, Marcaccini AM, Matos FTC, Sousa FL, Nascimento GC, Moura MEB. Integrative review on oral cancer. J res fundam care online [Internet]. 2014 Dec [cited 2018 Aug 15];6(Suppl):164-75. Available from: <http://www.seer.unirio.br/index.php/cuidadofundamental/article/view/4516>
15. Porto KRDA, Motti PR, Machado AA, Roel AR. In vitro evaluation of the effect of botanical <https://periodicos.ufpe.br/revistas/revistaenfermagem/index>

formulations used in the control of *Aedes aegypti* L. (Diptera: Culicidae) on liver enzymes. Rev Soc Bras Med Trop. 2016 Nov/Dec;49(6):693-7. DOI: [10.1590/0037-8682-0117-2016](https://doi.org/10.1590/0037-8682-0117-2016)

16. Wang L, Zhao H, Oliva SM, Zhu H. Modeling the transmission and control of Zika in Brazil. Scientific reports [Internet]. 2017 Aug [cited 2018 Aug 15];7:7721. Available from: <https://www.nature.com/articles/s41598-017-07264-y>

17. Reis NN, Silva AL, Reis EPG, Silva FC, Reis IGN. Viruses vector control proposal: genus *Aedes* emphasis. Braz J Infect Dis. 2017 July/Aug;21:457-63. DOI: [10.1016/j.bjid.2017.03.020](https://doi.org/10.1016/j.bjid.2017.03.020)

18. Evans HC; Elliot SL, Barreto RW. Entomopathogenic fungi and their potential for the management of *Aedes aegypti* (Diptera: Culicidae) in the Americas. Mem Inst Oswaldo Cruz. 2018 Mar;113:206-14. DOI: [10.1590/0074-02760170369](https://doi.org/10.1590/0074-02760170369)

19. Gomes ACA, Tavares DRAL, Beyruth GP, Palermo TAC, Santos CM. Educação em saúde para prevenção e controle do *Aedes aegypti*. Persp online biol & saúde. 2017 June;7(24):32-9. DOI: [10.25242/886872420171163](https://doi.org/10.25242/886872420171163)

20. Carolino AT, Gomes SA, Teodoro TBP, Samuels RI. Potencial de blastosporos de *Metarhizium Anisopliae* para o controle de adultos de *Aedes aegypti*. Revista univap. 2017;22:709. DOI: [10.18066/revistaunivap.v22i40.1472](https://doi.org/10.18066/revistaunivap.v22i40.1472)

21. Cazola LHO, Tamaki EM, Pontes ERJC, Andrade SMO. The incorporation of activities to control dengue by community health agents. Rev Saúde Pública. 2014 Feb;48:113-22. DOI: [10.1590/S0034-8910.2014048004687](https://doi.org/10.1590/S0034-8910.2014048004687)

22. Caprara A, Lima JWO, Peixoto ACR, Motta CM, Nobre JMS, Sommerfeld J, et al. Entomological impact and social participation in dengue control: a cluster randomized trial in Fortaleza, Brazil. Trans R Soc Trop Med Hyg. 2015 Feb;109:99-105. DOI: [10.1093/trstmh/tru187](https://doi.org/10.1093/trstmh/tru187)

23. Alfonso-Sierra E, Basso C, Beltrán-Ayala E, Mitchell-Foster K, Quintero J, Cortés S, et al. Innovative dengue vector control interventions in Latin America: what do they cost? Pathog Glob Health. 2016;110(1):14-24. DOI: [10.1080/20477724.2016.1142057](https://doi.org/10.1080/20477724.2016.1142057)

24. Freitas RM, Valle D. Challenges encountered using standard vector control measures for dengue in Boa Vista, Brazil. Bull World Health Organ. 2014 Sept;92(9):685-9. DOI: [10.2471/BLT.13.119081](https://doi.org/10.2471/BLT.13.119081)

25. Sarmiento UC, Migueta CH, Almeida LH, Gaban CR, Silva LM, Souza AS, et al. Larvicidal efficacies of plants from Midwestern Brazil: melianodiol from *Guarea kunthiana* as a potential biopesticide against *Aedes aegypti*. Mem Inst Oswaldo Cruz. 2016 June;111(7):469-74. DOI: [10.1590/0074-02760160134](https://doi.org/10.1590/0074-02760160134)

26. Salvador Neto O, Gomes SA, Soares AR, Machado FLS, Samuels RI, Fonseca RN, et al. Larvicidal potential of the halogenated sesquiterpene (+)-obtusol, isolated from the alga *Laurencia dendroidea* J. Agardh (Ceramiales: Rhodomelaceae), against the Dengue vector mosquito *Aedes aegypti* (Linnaeus)(Diptera: Culicidae). Marine drugs [Internet]. 2016 Jan [cited 2018 Aug 15];14(2):20. Available from: <https://www.mdpi.com/1660-3397/14/2/20>

27. Gesto JSM, Araki AS, Caragata EP, de Oliveira CD, Martins AJ, Bruno RV, et al. In tune with nature: *Wolbachia* does not prevent pre-copula acoustic communication in *Aedes aegypti*. Parasit Vectors [Internet]. 2018 Feb [cited 2018 Aug 15];11(1):109. Available from: <https://parasitesandvectors.biomedcentral.com/articles/10.1186/s13071-018-2695-x>

28. Lima Neto AS, Nascimento OJ, Sousa GDS. Dengue, Zika and Chikungunya - challenges for vector control given the occurrence of three arboviruses - part I. Rev Bras Promoç Saúde [Internet]. 2016 July/Sept [cited 2018 Aug 15];29(3):305-12. Available from: <https://periodicos.unifor.br/RBPS/article/view/5782/pdf>

29. Regis LN, Acioli RV, Silveira Jr JC, Santos MAVM, Souza WV, Ribeiro CMN, et al. Sustained reduction of the dengue vector population resulting from an integrated control strategy applied in two Brazilian cities. PLoS One. 2013 July;8(7):e67682. DOI: [10.1371/journal.pone.0067682](https://doi.org/10.1371/journal.pone.0067682)

30. Piovezan R, Acorinthe JPO, Visockas A, Azevedo TS, Von Zuben CJ. Effect of heavy-equipment aided environmental nebulization on *Aedes aegypti* vectors of Dengue, Zika and Chikungunya in São Paulo, Brazil. Bulletin of entomological research. 2017 Aug;107(4):478-86. DOI: [10.1017/S0007485316001115](https://doi.org/10.1017/S0007485316001115)

31. Caragata EP, Dutra HLC, Moreira LA. Inhibition of Zika virus by *Wolbachia* in *Aedes aegypti*. Microb cell. 2016 July;3(7):293-5. DOI: [10.15698/mic2016.07.513](https://doi.org/10.15698/mic2016.07.513)

32. Dutra HLC, Rodrigues SL, Mansur SB, Oliveira SP, Caragata EP, Moreira LA. Development and physiological effects of an artificial diet for *Wolbachia*-infected *Aedes aegypti*. Scientific reports [Internet]. 2017 Nov [cited 2018 Aug 15];7:15687. Available from: <https://www.nature.com/articles/s41598-017-16045-6>

33. Dutra HLC, Silva VL, Fernandes MR, Logullo C, Freitas RM, Moreira LA. The influence of larval competition on Brazilian *Wolbachia*-infected *Aedes aegypti* mosquitoes. Parasit Vectors. 2016 May;9(1):282. DOI: [10.1186/s13071-016-1559-5](https://doi.org/10.1186/s13071-016-1559-5)

34. Dutra HLC, Rocha MN, Dias FBS, Mansur SB, Caragata EP, Moreira LA. *Wolbachia* blocks <https://periodicos.ufpe.br/revistas/revistaenfermagem/index>

currently circulating Zika virus isolates in Brazilian *Aedes aegypti* mosquitoes. *Cell Host Microbe*. 2016 June;19(6):771-4. DOI:

[10.1016/j.chom.2016.04.021](https://doi.org/10.1016/j.chom.2016.04.021)

35. Dutra HLC, Dos Santos LMB, Caragata EP, Silva JBL, Villela DA, Maciel-de-Freitas R, et al. From lab to field: the influence of urban landscapes on the invasive potential of *Wolbachia* in Brazilian *Aedes aegypti* mosquitoes. *PLoS neglected tropical diseases*. 2015 Apr;9(4):e0003689. DOI:

[10.1371/journal.pntd.0003689](https://doi.org/10.1371/journal.pntd.0003689)

36. Winskill P, Carvalho DO, Capurro ML, Alphey L, Donnelly CA, McKemey AR. Dispersal of engineered male *Aedes aegypti* mosquitoes. *PLoS Negl Trop Dis*. 2015 Nov;9(11):e0004156. DOI:

[10.1371/journal.pntd.0004156](https://doi.org/10.1371/journal.pntd.0004156)

37. Andrade PP, Aragão FJL, Colli W, Dellagostin OA, Finardi-Filho F, Hirata MH, et al. Use of transgenic *Aedes aegypti* in Brazil: risk perception and assessment. *Bull World Health Organ*. 2016 Oct;94(10):766-71. DOI:

[10.2471/BLT.16.173377](https://doi.org/10.2471/BLT.16.173377)

38. Carvalho DO, Nimmo D, Naish N, McKemey AR, Gray P, Wilke AB, et al. Mass production of genetically modified *Aedes aegypti* for field releases in Brazil. *J Vis Exp*. 2014 Jan;83:e3579. DOI:

[10.3791/3579](https://doi.org/10.3791/3579)

39. Paiva CN, Lima JWO, Camelo SS, Lima CF, Cavalcanti LPG. Survival of larvivor fish used for biological control of *Aedes aegypti* (Diptera: Culicidae) combined with different larvicides. *Trop Med Int Health*. 2014 June;19(9):1082-6. DOI:

[10.1111/tmi.12341](https://doi.org/10.1111/tmi.12341)

40. Abad-Franch F, Zamora-Perea E, Luz SLB. Mosquito-disseminated insecticide for citywide vector control and its potential to block arbovirus epidemics: entomological observations and modeling results from Amazonian Brazil. *PLoS Med*. 2017 Jan;14(1):e1002213. DOI:

[10.1371/journal.pmed.1002213](https://doi.org/10.1371/journal.pmed.1002213)

41. Caixeta ES, Silva CF, Santos VSV, Campos Júnior EO, Pereira BB. Ecotoxicological assessment of pyriproxyfen under environmentally realistic exposure conditions of integrated vector management for *Aedes aegypti* control in Brazil. *J Toxicol Environ Health A*. 2016;79(18):799-803. DOI:

[10.1080/15287394.2016.1191400](https://doi.org/10.1080/15287394.2016.1191400)

42. Pereira BB, Caixeta ES, Freitas PC, Santos VSV, Limongi JE, Campos Júnior EO, et al. Toxicological assessment of spinosad: Implications for integrated control of *Aedes aegypti* using larvicides and larvivor fish. *J Toxicol Environ Health A*. 2016;79(12):477-81. DOI:

[10.1080/15287394.2016.1176974](https://doi.org/10.1080/15287394.2016.1176974)

43. Souza RL, Mugabe VA, Paploski IAD, Rodrigues MS, Moreira PSDS, Nascimento LCJ, et al. Effect of an intervention in storm drains to prevent *Aedes aegypti* reproduction in Salvador,

Brazil. *Parasit Vectors*. 2017 July;10(1):328. DOI:

[10.1186/s13071-017-2266-6](https://doi.org/10.1186/s13071-017-2266-6).

44. Chediak M, Pimenta Jr FG, Coelho GE, Braga IA, Lima JBP, Cavalcante KRL, et al. Spatial and temporal country-wide survey of temephos resistance in Brazilian populations of *Aedes aegypti*. *Mem. Inst Oswaldo Cruz*. 2016 May/Apr;111(5):311-21. DOI:

[10.1590/0074-02760150409](https://doi.org/10.1590/0074-02760150409)

45. Mesquita FOS, Parente AS, Coelho GMP. Community health agents and agents to combat endemic diseases: Challenges to control *Aedes aegypti*. *Id on Line Rev Psic [Internet]*. 2017 July [cited 2018 Aug 11];11(36):64-77. Available from:

<https://idonline.emnuvens.com.br/id/article/view/764>

46. Paula AR, Ribeiro AR, Silva LEI, Samuels RI. Monitoramento e redução da população de *aedes aegypti* com fungos entomopatogênicos em São João da Barra-RJ. *Rev Univap*. 2016;22(40):60. DOI:

[10.18066/revistaunivap.v22i40.1219](https://doi.org/10.18066/revistaunivap.v22i40.1219)

47. Aguiar ME, Mota A. The Family Health Program in the Bom Retiro district, São Paulo, Brazil: communication between Bolivians and healthcare workers. *Interface comun saúde educ*. 2014 July/Sept;18(50):493-506. DOI:

[10.1590/1807-57622013.0040](https://doi.org/10.1590/1807-57622013.0040)

48. Cançado MSM, Barbosa MA, Teixeira RAG, Oliveira ESF. Perceptions of representatives of a committee against dengue in the health education actions, Goiás, Brazil. *Rev Esc de Enferm USP*. 2014 Dec;48(2):94-104. DOI:

[10.1590/S0080-623420140000800015](https://doi.org/10.1590/S0080-623420140000800015)

49. Janini JP, Bessler D, Vargas AB de. Health education and health promotion: impact on quality of life of elderly. *Saúde Debate*. 2015 Apr/June;39(105):480-90. DOI:

[10.1590/0103-110420151050002015](https://doi.org/10.1590/0103-110420151050002015)

50. Oliveira FLB, Millions RM, Costa MV, Almeida Júnior JJ, Silva DGKC. Comparative study of nursing practice on dengue control and fever chikungunya. *Saúde Soc*. 2016 Oct/Sept;25(4):1031-8. DOI:

[10.1590/s0104-12902016160638](https://doi.org/10.1590/s0104-12902016160638)

51. Regis L, Monteiro AM, Melo-Santos MA, Silveira JC Jr, Furtado AF, Acioli RV, et al. Developing new approaches for detecting and preventing *Aedes aegypti* population outbreaks: basis for surveillance, alert and control system. *Mem Instit Oswaldo Cruz*. 2008 Feb;103(1):50-9. DOI:

[10.1590/s0074-02762008000100008](https://doi.org/10.1590/s0074-02762008000100008)

52. Regis LN, Acioli RV, Silveira JC Jr, Melo-Santos MA, da Cunha MC, Souza F, et al. Characterization of the spatial and temporal dynamics of the dengue vector population established in urban areas of Fernando de Noronha, a Brazilian oceanic island. *Acta Trop*. 2014 Sept;137:80-7. DOI:

[10.1016/j.actatropica.2014.04.010](https://doi.org/10.1016/j.actatropica.2014.04.010)

https://sigarra.up.pt/icbas/pt/pub_geral.pub_vie_w?pi_pub_base_id=173763

53. Joubert DA, Walker T, Carrington LB, Bruyne JT, Kien DHT, Hoang NIT, *et al.* Establishment of a Wolbachia superinfection in *Aedes aegypti* mosquitoes as a potential approach for future resistance management. *PLoS Patho.* 2016 Feb;12(2):e1005434. DOI:

[10.1371/journal.ppat.1005434](https://doi.org/10.1371/journal.ppat.1005434)

54. Kamtchum-Tatuene J, Makepeace BL, Benjamin L, Baylis M, Solomon T. The potential role of Wolbachia in controlling the transmission of emerging human arboviral infections. *Curr opin infect dis.* 2017 Feb;30(1):108-16. DOI:

[10.1097/QCO.0000000000000342](https://doi.org/10.1097/QCO.0000000000000342)

55. Lambrechts L, Ferguson NM, Harris E, Holmes EC, McGraw EA, O'Neill SL, *et al.* Assessing the epidemiological effect of Wolbachia for dengue control. *Lancet Infect Dis.* 2015 July; 15(7):862-6. DOI:

[10.1016/S1473-3099\(15\)00091-2](https://doi.org/10.1016/S1473-3099(15)00091-2)

56. Wilke AB, Gomes Ade C, Natal D, Marrelli MT. Control of vector populations using genetically modified mosquitoes. *Rev Saúde Pública.* 2009 Oct;43(5):869-74. DOI:

[10.1590/s0034-89102009005000050](https://doi.org/10.1590/s0034-89102009005000050)

57. Souza LRS. Viabilidade econômica da TIE (Técnica do Inseto Estéril) no controle epidemiológico do mosquito *Aedes aegypti* [thesis]. São Paulo: Universidade de São Paulo; 2015. DOI:

[10.11606/D.11.2015.tde-22042015-145001](https://doi.org/10.11606/D.11.2015.tde-22042015-145001)

58. Silva EL, Arruda EJ, Andrade CFS, Fernandes MF, Teixeira TZ, Scudeler CGS, *et al.* Susceptibility evaluation to temephos of *Aedes aegypti* (Diptera: Culicidae) populations from the Municipalities of Maracaju and Naviraí, Mato Grosso do Sul State, Brazil. *Bio Assay.* 2015;10:01. DOI:

[10.14295/BA.v10.141](https://doi.org/10.14295/BA.v10.141)

59. Garcia Neto LJ. Efeito residual do Diflubenzuron sobre larvas de *Aedes aegypti* em condições simuladas de campo, no laboratório [dissertation][Internet]. Fortaleza: Universidade Estadual do Ceará; 2011 [cited 2018 Aug 10]. Available from:

http://uece.br/cmasp/dmdocuments/levindo_garcia.pdf

60. Pires BMP. Avaliação de Piriproxifeno como ferramenta para estratégias de controlo vetorial de *Aedes aegypti* (Linnaeus, 1762) na Ilha da Madeira: estudo piloto na região do Paúl do Mar [dissertation][Internet]. Lisboa: Instituto de Higiene e Medicina Tropical; 2015 [cited 2018 Aug 10]. Available from:

<https://run.unl.pt/handle/10362/19830>

61. Mogas ARMYA. Combinação simultânea de peixes larvívoros com pesticidas como uma estratégia de controlo de vetores da malária: um estudo experimental com *Poecilia reticulata* e três pesticidas. [dissertation][Internet] Porto: Universidade do Porto; 2016 [cited 2018 Aug 10]. Available from:

Corresponding author

Diane Sales Vieira

E-mail: dianesales.enf@hotmail.com

Submission: 2018/06/28

Accepted: 2019/10/07

Copyright© 2019 Journal of Nursing UFPE on line/JNOUL.

This is an Open Access article distributed under the terms of the [Creative Commons Attribution-ShareAlike 4.0 International License](https://creativecommons.org/licenses/by-sa/4.0/). This license lets others distribute, remix, tweak, and build upon your work, even commercially, as long as they credit you for the original creation. Recommended for maximum dissemination and use of licensed materials.

<https://periodicos.ufpe.br/revistas/revistaenfermagem/index>