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ENVIRONMENTAL SURVEILLANCE ANDO CONTROL ACTIONS FOR DENGUE PREVENTION: A CASE STUDY IN THE ALTO URUGUAI GAÚCHO REGION, RIO GRANDE DO SUL STATE, BRAZIL

AÇÕES DE VIGILÂNCIA AMBIENTAL E CONTROLE PARA PREVENÇÃO DA DENGUE: UM ESTUDO DE CASO NA REGIÃO DO ALTO URUGUAI GAÚCHO, ESTADO DO RIO GRANDE DO SUL, BRASIL

ACCIONES DE VIGILANCIA Y CONTROL AMBIENTAL PARA LA PREVENCIÓN DEL DENGUE: UN ESTUDIO DE CASO EN LA REGIÓN DEL ALTO URUGUAI GAÚCHO, ESTADO DE RIO GRANDE DO SUL, BRASIL

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ABSTRACT

Dengue is an acute febrile disease of viral etiology, presenting as benign in its classic form and severe in its hemorrhagic form. It is the most significant arboviral disease, posing a serious global public health issue in tropical and subtropical countries where environmental conditions favor the proliferation of Aedes aegypti. In Brazil, dengue arrived in the 18th century. Most of the population lives in urban areas, where challenges include ensuring regular water supply, adequate waste collection and disposal, and addressing climatic conditions. This study aims to examine the routine actions of endemic agents, considering the number of identified cases, Aedes aegypti mosquito breeding sites, and the current epidemiological status of the disease in the Alto Uruguai region of Rio Grande do Sul between 2019 and 2024. Dengue cases in Alto Uruguai Gaúcho increased in 2021, 2022, and 2024, likely due to elevated temperatures and rainfall, which contributed to a rise in mosquito breeding sites and consequently more infections. Therefore, it is essential to enhance actions

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such as waste collection drives and educational campaigns for dengue prevention and control, as public awareness and cooperation are crucial for managing the disease.

Keywords: Public Health. Infectious Disease. *Aedes aegypti.*

RESUMO

A dengue, doença febril aguda, de etiologia viral e de evolução benigna na forma clássica; grave, na forma hemorrágica, é, a mais importante arbovirose, que afeta as pessoas sendo um sério problema de saúde pública mundial, nos países tropicais e subtropicais, onde as condições do meio ambiente favorecem a proliferação do Aedes aegypti. No Brasil, chegou no século XVIII. A maioria da população, no país, vive nas áreas urbanas, onde há dificuldade de garantir abastecimento regular de água, coleta e destino adequado dos resíduos sólidos, e condições climáticas. Neste trabalho, o objetivo será abordar as ações de rotina dos agentes de endemias, considerando: número de casos identificados, focos do mosquito Aedes aegypti e quadro atual epidemiológico da doença, no período entre 2019 e 2024, nos municípios do Alto Uruguai, Rio Grande do Sul. Os casos de dengue no Alto Uruguai Gaúcho, aumentaram em 2021, 2022 e 2024 provavelmente em função das temperaturas elevadas e chuvas, aumentando os focos de dengue, ocasionando mais casos de pessoas infectadas. Desta forma, é preciso promover mais ações, como mutirões para recolhimento de resíduos sólidos e ações educativas, de prevenção e controle da dengue, pois a população precisa se conscientizar e colaborar, para controlar a doença.

Palavras-chave: Saúde Pública. Doença Transmissível. *Aedes aegypti*.

RESUMEN

Dengue, enfermedad febril aguda de etiología viral y de curso benigno en su forma clásica; La gripe aviar grave, en su forma hemorrágica, es el arbovirus más importante que afecta a las personas y constituye un grave problema de salud pública mundial en los países tropicales y subtropicales, donde las condiciones ambientales favorecen la proliferación del Aedes aegypti. La mayoría de la población del país vive en zonas urbanas, donde es difícil garantizar el suministro regular de agua, la recolección y disposición adecuada de residuos sólidos y las condiciones climáticas. En este trabajo, el objetivo será abordar las acciones rutinarias de los agentes endémicos, considerando número de casos identificados, focos del mosquito Aedes aegypti y cuadro epidemiológico en el período comprendido entre 2019 y 2024, en los municipios de Alto Uruguai, Rio Grande do Sul. Los casos de dengue en Alto Uruguai Gaúcho aumentaron en 2021, 2022 y 2024 probablemente debido a las altas temperaturas y lluvias, aumentando los focos de dengue, provocando más casos de personas infectadas. Por ello, es necesario promover más acciones, como trabajos conjuntos de recolección de residuos sólidos y acciones educativas para prevenir y controlar el dengue ya que la población necesita tomar conciencia y colaborar para controlar la enfermedad.

Palabras clave: Salud Pública. Enfermedad Transmisible. *Aedes aegypti*.

1 INTRODUCTION

As diseases in general that affect the population in Brazil, dengue has stood out as one of the most important reemerging diseases in the world. In Brazil, from the 1980s onwards, a process of intense viral circulation began, with explosive epidemics that reached all Brazilian regions[1]. Dengue, according to the Ministry of Health2, is an acute febrile infectious disease, which can present in a benign or severe form, depending on some factors, including: the virus involved, previous infection with the dengue virus, and individual factors such as chronic diseases (diabetes, bronchial asthma, sickle cell anemia).

Currently, the state of Rio Grande do Sul is on high alert for dengue. According to data from the Health Department of Rio Grande do Sul (SES/RS), confirmed cases have increased a lot in 2024, with death records. Taking into account the current endemic situation, the State should promote epidemiological and environmental surveillance actions in the fight against dengue, aiming to control the disease.

Thus, there are several actions to monitor the occurrence of dengue such as the study of environmental health and public health, considering that this work is interesting to have knowledge of the way of life and behavior of the A. aegypti mosquito in relation to the environment.

1.1 EPIDEMIOLOGICAL ASPECTS OF DENGUE

Dengue is one of the main public health problems in the world. The World Health Organization (WHO) estimates that 2.5 billion people – 2/5 of the world's population – are at risk of contracting dengue fever and that about 50 million cases occur annually. Of this total, about 550 thousand victims of hospitalization and at least 20 thousand die as a result of the disease[3]. The mosquito that transmits dengue fever has its origin in Egypt, Africa, and has been spreading through the tropical and subtropical regions of the planet since the 16th century, the period of the Great Navigations. The vector was introduced in the colonial period by means of ships that trafficked slaves. It was scientifically described in 1762, when it was named *Culex aegypti*, and later, *Aedes aegypti* in 1818, when the genus Aedes was described. The Pan American Health Organization (PAHO) states that the first dengue epidemic in the American continent occurred in Peru in the early 19th century, with outbreaks in the Caribbean, the United States, Colombia and Venezuela[4]. In Brazil, the first dengue epidemic occurred in 1981-1982, in Boa Vista (RR). In 1986, epidemics occurred in Rio de Janeiro and in some capitals of the Northeast region. In the 1986 epidemic, the DENV1 serotype was agreed in the State of Rio de Janeiro, and then for six other states until 1990. Dengue cases have been concomitantly increasing, in several Brazilian states and

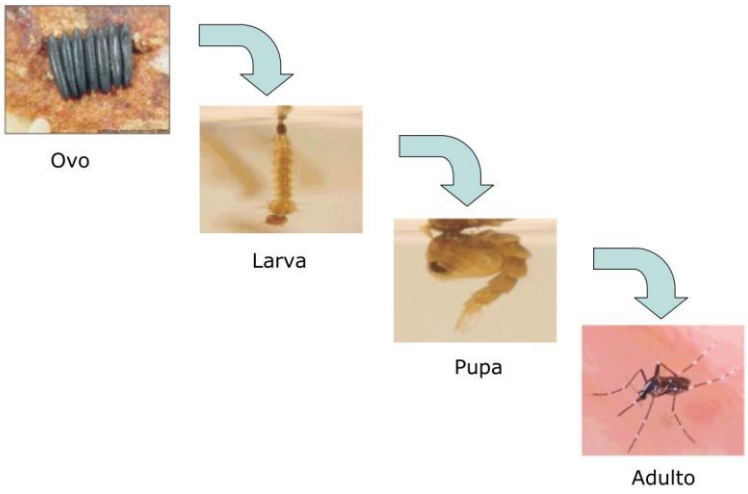
alarmingly, since 1986. Transmission is through the bite of Aedes aegypti mosquitoes in humans. After an infected blood meal, the mosquito is able to transmit the virus, after 8 to 12 days of incubation. There is no transmission by direct contact of a sick person or his secretions with a healthy person, nor from sources of water or food. Transmission occurs while there is virus in human blood (viremia period). This period begins one day before the onset of fever and lasts until the 6th day of the disease[3]. Dengue can manifest itself in a mild form (Classic Dengue) or severe (Hemorrhagic Dengue). The symptoms of Classic Dengue are: high fever, muscle and joint pain, headache and eye pain; nausea and vomiting; reddish spots on the body; weakness and dejection. And the symptoms of Hemorrhagic Dengue are: high fever, muscle and joint pain; headache and eye pain; persistent nausea and vomiting; severe and continuous abdominal pain and generalized hemorrhages (mouth, nose, feces, urine)[3]. While in Classic Dengue, the treatment consists of adequate hydration and safety, in Hemorrhagic Dengue the patient must be hospitalized, as there is a risk of death[3]. Although it is not possible to predict whether or not a patient with classic dengue will become a case of dengue hemorrhagic fever (DHF), it is known that if this evolution occurs, it is necessary to intervene as soon as possible to prevent it from evolving to dengue shock, a much more serious situation that, due to its complications, can lead to death[5].

1.2 CHARACTERISTICS OF THE *AEDES AEGYPTI MOSQUITO*

The *Aedes aegypti mosquito* is on average less than 1 centimeter in size. Smaller than common mosquitoes, it is black with white stripes on the trunk, head and legs. It is an urban mosquito, from tropical and subtropical regions, it does not resist very low temperatures. The *Aedes* usually has its circulation intensified in the summer, due to the combination of warmer temperature and rainfall. To reproduce, it needs places with standing water6. The male feeds exclusively on fruits. The female needs blood for the maturation of the eggs that are deposited on the edges of the inner side of the containers with rainwater. On average, the mosquito lives around 30 days and the female lays between 150 and 200 eggs. The life cycle of *A. aegypti* is divided into 4 stages in a period that varies between seven and nine days, until it gives rise to a new mosquito: egg, larva, pupa, and adult mosquito (figure 1). The female lays her eggs, above the water, on the edges. When they come into contact with water, depending on the temperature, they become larvae and at this stage they feed on organic matter, and after 2 to 3 days, they become pupae, and do not feed. After another 2 days, it reaches the winged form, that is, adult mosquito.

Figure 1

The life cycle of *A. aegypti* is divided into 4 stages: egg, larva, pupa, and adult mosquito



Source: Biology of the Dengue Vector Espírito Santo Health Department.

1.3 MEASURES TO COMBAT AND CONTROL DENGUE

In Brazil, the management and execution of PNCD actions are carried out by the municipal health departments, with the support of the states and the Ministry of Health when necessary, with the federal level being responsible for most of the funding5. In Alto Uruguai Gaúcho, the endemic agents have the support of other sectors when there are many mosquito outbreaks in places with garbage accumulation with containers that can be conducive to having dengue outbreaks. Pieniz *et al* [7], state that the "active participation of management becomes a triangular stone for the effectiveness of actions as well as their continuity".

The act of dengue prevention "must carry out epidemiological surveillance actions with the knowledge, detection or prevention of any change in the determinant and conditioning factors of individual or collective health, with the purpose of recommending and adopting measures for the prevention and control of diseases", according to Federal Law No. 8,080, art. 6, Paragraph 2 [8]. The Endemic agents have all the support of the law, and the Environmental Health Surveillance to inspect places that have deposits with standing water that offer danger, or risks of contracting dengue, in the courtyards of residences or public or private places.

2 METHODOLOGY

This research is exploratory in nature with the purpose of analyzing existing data on a worrying public and environmental health problem, which are the cases of dengue that have been occurring in recent years in Rio Grande do Sul and in the municipalities of Alto Uruguai.

Compare the increase in the number of cases in Rio Grande do Sul with the increase in the number of cases in Alto Uruguai, in 2021, 2022 and 2024.

2.1 CHARACTERIZATION OF THE AREA

The territorial area of the Municipalities of Alto Uruguai Gaúcho is 6,396.774 km² and has a population of 231,712 inhabitants9. The altitude is, on average, 783 meters above sea level, the climate being subtropical, and the average temperature is 18.7ºC.

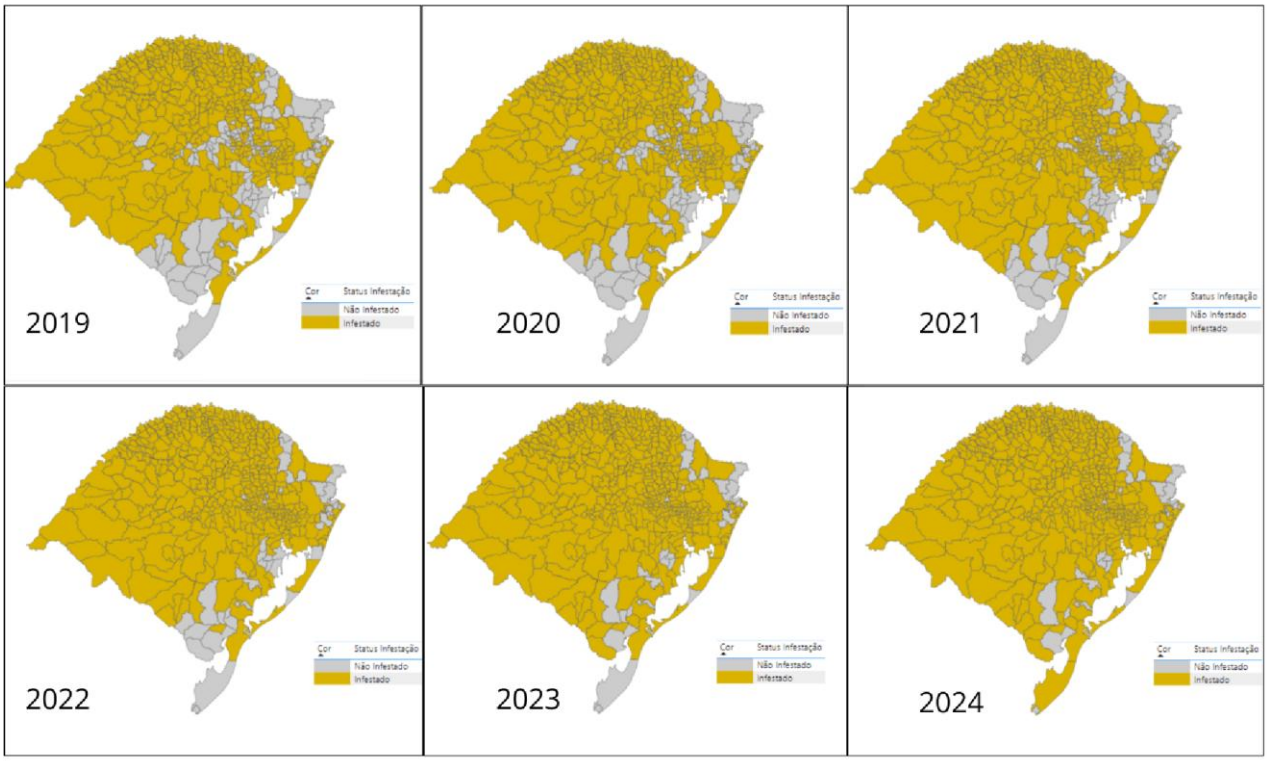
3 RESULTS AND DISCUSSIONS

3.1 DENGUE CASES IN RIO GRANDE DO SUL, IN THE PERIOD OF 2019, 2020, 2021, 2022, 2023 and 2024

In 2024, until June 23, 255,829 notifications were made, with 165,871 confirmed cases, of which 260 died, surpassing the data of the last 6 years10. In 2020, the percentage of confirmed cases rose by 270% compared to the previous year. In 2021, the increase was 291% compared to 2020. Considering the year 2022, 67,345 confirmed cases were registered, with a 633% increase compared to 2021, that is, 56,721 new cases registered. In 2023, confirmed cases were 38,743, down about 73% compared to 2022. In 2024, until June, the percentage of cases increased to 428% compared to the previous year. Considering the number of deaths, in 2019 there were no records. In 2020, 6 deaths were recorded, in 2021 there were 11 deaths, 83% more than in the previous year. In 2022, 66 deaths were recorded, an increase of 600%, compared to 2021. In 2023, the number of deaths fell to 54, registering a percentage of 22% less compared to 2022. And in 2024, there were 260 deaths, with 393% more than in 2023.

Figure 2

Geographic location of municipalities with Dengue cases in the state of Rio Grande do Sul in 2019, 2020, 2021, 2022, 2023 and 2024



Source: Rio Grande do Sul Health Department (SES/RS), 2019, 2020, 2021, 2022, 2023 and 202410.

Table 1

Panel of dengue cases in RS State Health Secretariat/RS (SES/RS)[10], in the period 2019, 2020, 2021, 2022, 2023 and 2024 (until mid-June

	2019	**2020**	**2021**	**2022**	**2023**	**2024**
Confirmed	1.346	3.645	10.624	67.345	38.743	165.871
Native (contracted within the state)	1.192	3.344	10.247	57.938	34.842	134.941
Deaths	0	6	11	66	54	260

Source: authors, 2024, based on data from the Dengue Panel in RS/State Health Secretariat/RS (SES/RS)[10]

Dengue cases increased in the years 2021, 2022 and 2024, probably due to high temperatures and frequent rains, consequently increasing the outbreaks, causing more cases of infected people.

3.2 DATA ON DENGUE CASES IN THE MUNICIPALITY OF ERECHIM, IN THE PERIOD OF 2019, 2020, 2021, 2022. 2023 and 2024 (until June 21).

In table 2, below, we show in the Dengue Cases Panel, in the municipality of Erechim, the dengue cases, referring to the period of 2019, 2020, 2021, 2022, 2023 and 2024 (January to June 21). In 2019, 3 people were confirmed, 2 autochthonous, which means that they contracted the disease within the Alto Uruguai Gaúcho region, and no confirmed deaths. In 2020, 8 people were confirmed, 3 autochthonous, and no deaths. In 2021, 3,892 people were confirmed, 3,830 autochthonous and 4 deaths. In 2022, 486 people, 483 autochthonous cases, and one death were confirmed in Erechim (January to June 9)[10].

Table 2

Panel of Dengue cases in the municipalities of Alto Uruguai Gaúcho, RS/State Health Department/RS (SES/RS)[10], records identified until mid-June 2024

	2019	**2020**	**2021**	**2022**	**2023**	**2024**
Confirmed	3	8	3.892	1.321	120	1.595
Native (contracted within the state)	2	3	3.830	1.239	87	1.332
Deaths	0	0	4	1	0	4

Source: authors, 2024, based on data from the Dengue Panel in RS/State Health Secretariat/RS (SES/RS)[10], recorded for the municipalities of Alto Uruguai Gaúcho until June 21, 2024.

In 2019, there were 3 confirmed cases, 2 autochthonous (who contracted the disease in the Region of

Alto Uruguai Gaúcho), however, no deaths were reported. In 2020 there were 8 confirmed cases, 3 of which were autochthonous, and no deaths. In 2021, there were 3,892 confirmed cases, 3,830 autochthonous and 4 deaths. In 2022, there were 1,321 confirmed cases, and 1,239 autochthonous people, and one death. In 2023, Alto Uruguai Gaúcho had 120 confirmed cases, with 87 autochthonous and no deaths; and in 2024, so far (June 21), the municipalities of Alto Uruguai Gaúcho, have already had 1,595 confirmed cases, 1,332 autochthonous and 4 deaths. Dengue cases increased in 2021 and 2022, probably due to high temperatures and frequent rains, increasing dengue outbreaks, causing more cases of infected people. The numbers relapsed in 2023 and rose exponentially in 2024, possibly due to the floods recorded in the region. Lima et al (2008)[11] comment that dengue cases also increase in the rainy season, as did Alto Uruguai Gaúcho in 2021, 2022 and 2024. Compared

to dengue cases in Rio Grande do Sul, with dengue cases, in Alto Uruguai Gaúcho, the state and municipalities had an increase in the number of cases in 2021, 2022 and 2024.

3.3 ROUTINE ACTIONS IN THE ALTO URUGUAI REGION OF RIO GRANDE DO SUL

In 2002, the National Dengue Control Plan (PNCD) was created by the Federal Government12. It is a permanent program, for the whole country and all municipalities are part of this program. It aims to exercise permanent surveillance and is part of Health Surveillance and is responsible for recording daily inspections, to verify the infestation rate in properties. In Alto Uruguai Gaúcho, activities to combat the dengue mosquito are carried out throughout the year, through routine inspections by the Endemic Combat Agents. The agents inspect homes, land, businesses, that is, all properties, in compliance with the standards of the Ministry of Health.

3.4 POSSIBLE BREEDING SITES AND SOLID WASTE

Numerical data on the distribution and types of breeding sites were not informed by the municipal health departments of Alto Uruguai, because there is no record.

Deposits with accumulated rainwater are the most important causes of mosquito breeding sites, such as containers in vacant lots with water accumulation and disused toilets6. Below, in figure 3, a possible breeding ground is pointed out in rainwater collection gutters, with dengue mosquito foci, in the municipality of Aratiba/RS, in 2024 and, in figure 4, we observe an accumulation of waste, with dengue mosquito foci highlighting garbage accumulation, in the municipality of Aratiba/RS, in 2024.

Figure 3

Source: Authors, 2024

3.4 PRECIPITATION AND TEMPERATURE

Dengue presents a seasonal behavior in the country, occurring mainly between the months of October and May13, which is where high temperatures and rainfall occur, causing more dengue mosquito outbreaks. Beserra *et al*, (2009)[14] comments that the temperature favorable to the development of *Aedes aegypti* is between 22º C and 32º C. In the scenario presented for Alto Uruguai Gaúcho, the points where the average temperature is above 18ºC, and the highest amount of rainfall were recorded in the months of May and June 2024, were the most favorable to the proliferation of the mosquito. According to Donalísio (2002)[15], climatic conditions have a strong association established between the incidence of dengue and rainy seasons and high temperatures.

4 FINAL CONSIDERATIONS

Considering the confirmed cases in 2019, there were 1,346 and in 2020 this number grew to 3,645, an increase of 170%[10]. In 2021, confirmed cases were 10,589 with an increase of 190% compared to 2020, that is, 6,499 new cases registered. The year 2022 draws attention, as 67,345 confirmed cases were registered, with a 535% increase compared to 2021, that is, 56,756 new cases registered by mid-2022. In 2023, confirmed cases were 38,743, down about 73% compared to 2022. In 2024, until June, the percentage of cases increased to 428% compared to the previous year. Considering the number of deaths, in 2019 there were no records. In 2020, 6 deaths were recorded, in 2021 there were 11 deaths, 83% more than in the previous year. In 2022, 66 deaths were recorded, an increase of 600%, compared to 2021. In 2023, the number of deaths fell to 54, registering a percentage of 22% less compared to 2022. And in 2024, there were 260 deaths, with 393% more than in 2023. The number of A. *aegypti foci* has been growing continuously in the upper Uruguay of Rio Grande do Sul and in the state of Rio Grande do Sul with the presence of the vector. Since 2011, the state has had autochthonous cases of dengue and from 2021, 2022 and 2024 a significant increase was recorded with a higher number of notifications of the disease, including an increase in the number of deaths. Regions with temperatures above 20ºC and high rainfall are favorable to the development of the dengue vector in our state. Therefore, it is suggested that the environmental conditions mentioned in this work be considered in planning actions to prevent and combat the dengue mosquito. Considering the rapid increase in the occurrence of the disease in the years 2021, 2022 and mid-2024, due to the increase in the number of cases and increased proliferation of the vector, it is necessary to continue monitoring the level of infestation of the vector to contribute to the plan to combat dengue. The actions of inspections of the properties are extremely urgent to promote monthly joint

efforts, to combat dengue, to reduce the foci of the *Aedes aegypti* mosquito. Other activities that should be promoted and with a wide range of the population are educational actions, in schools, in groups of the elderly, with guidelines to combat the dengue mosquito, carried out by agents to combat endemics, with lectures and distribution of information about dengue, as well as carrying out activities to mobilize the population, through the media, radios, newspapers, TV. The fight against the dengue mosquito is done by eliminating standing water, so that it cannot lay its eggs and does not have mosquito breeding grounds. The elimination of mosquito breeding sites is a complex task in urban areas, where there are precarious conditions in and around homes; inadequate sanitation and irregular garbage collection. Since the reduction of breeding sites depends on raising awareness among the population, reinforcing the need for changes in habits, since dengue is a public health problem and the solution depends on the joint attitudes of the population in partnership with public management. There are difficulties in combating this mosquito, as its proliferation and limitations to reduce its infestation rates, generated by the complexity of urban life. Inadequate disposal of solid waste which, in rainy periods, accumulates water, vacant lots and residences, which are not carried out frequent cleaning. Thus, it is not possible to prevent cases of dengue in areas infested by the A. *aegypti* mosquito, it is possible to prevent large epidemics by improving epidemiological surveillance.

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