Check for updates

ORIGINAL ARTICLE

Epidemiological Analysis of Arboviruses in the Triângulo Mineiro from 2014 to 2018

Análise Epidemiológica das Arboviroses no Triângulo Mineiro no Período de 2014 a 2018

João Vítor Gomes Pires[1] iD , **Noah Romero Nakajima**[1] iD , **Wallisen Tadashi Hattori**[2] iD , **Stefan Vilges de Oliveira**[2,*] iD

[1]*Medical School, Federal University of Uberlândia. Uberlândia, Minas Gerais, Brazil.*
[2]*Public Health Department, Medical School, Federal University of Uberlândia. Uberlândia, Minas Gerais, Brazil.*

ABSTRACT

Objective: To study the pattern of presentation of arbovirus cases in the Triângulo Mineiro region, Minas Gerais, Brazil.
Methods: Cross-sectional, descriptive study with quantitative analysis of data obtained from the Information System of Notifications of Diseases of the Ministry of Health from 2014 to 2018.
Results: 106,040 cases of Dengue, 1,691 of Zika, and 421 of Chikungunya were reported. The year with the most Dengue and Zika notifications was 2016; Chikungunya was in 2017. The municipalities with the highest incidence were Água Comprida, Gurinhatã and Araporã, while the lowest were Cascalho Rico, Indianópolis and Cachoeira Dourada. There were more reports from adult females.
Conclusion: In the studied region, there was the simultaneous circulation of the three investigated arboviruses, especially Dengue, similar to other Brazilian regions. This study can contribute to planning public policies for the prevention and control of arboviruses.

*Corresponding author:
Universidade Federal de Uberlândia, Faculdade de Medicina, Departamento de Saúde Coletiva, Campus Umuarama, Bloco 2U, Sala 8
Addr.: Av. Pará, 1720. Bairro Umuarama. Uberlândia, MG, Brasil | CEP 38.405-320
Phone: +55 (34) 3225-8273
E-mail: stefan@ufu.br (de Oliveira SV)

RESUMO

Objetivo: Estudar o padrão de apresentação dos casos de arboviroses na região do Triângulo Mineiro, Minas Gerais, Brasil.
Métodos: Estudo transversal, descritivo, com análise quantitativa de dados obtidos do Sistema de Informação de Agravos de Notificações do Ministério da Saúde dos anos de 2014 a 2018.
Resultados: Foram registrados 106.040 casos de Dengue, 1.691 de Zika e 421 de Chikungunya. O ano com mais notificações de Dengue e Zika foi 2016; já Chikungunya foi 2017. Os municípios com maior incidência foram Água Comprida, Gurinhatã e Araporã, enquanto os de menor foram Cascalho Rico, Indianópolis e Cachoeira Dourada. Houve mais notificações de adultos do sexo feminino.
Conclusão: Na região estudada houve circulação simultânea das três arboviroses investigadas, com destaque para a dengue, semelhante a outras regiões brasileiras. Este estudo pode contribuir com o planejamento de políticas públicas de prevenção e controle de arboviroses.

INTRODUCTION

Arboviruses are viral diseases transmitted by hematophagous arthropod vectors[1]. In Brazil, Dengue (DENV), Chikungunya (CHIKV) and Zika (ZIKV) are the major viruses that have a significant impact on public health[2].

Notably, the tropical climate favors the reproduction of *Aedes aegypti*, the main vector of arboviruses in the country, particularly during the rainy season[2]. Moreover, due to the simultaneous circulation of four DENV serotypes, CHIKV and ZIKV, these arthropod-borne diseases represent a serious challenge for care and surveillance regarding their measures to identify suspected cases, in early diagnosis and in triggering prevention and control actions[3].

The clinical manifestations of arboviruses range from mild fevers with a benign course to severe hemorrhagic syndromes, severe arthralgia, and neurological alterations. The similarity of clinical symptoms of these diseases is a complicating factor in the diagnostic process, especially in endemic areas[2].

The Southeast region was the most affected by DENV in the first quarter of 2019, accounting for about 65.4% of confirmed cases in Brazil. The state of Minas Gerais ranked second with the highest number of cases (24.0%), with São Paulo being the first (36.2% of cases in Brazil)[4]. Furthermore, it is worth noting the high costs associated with disease control. In 2016, the amount spent by the country was R$ 323,937,946, considering the funds to combat the vector, direct medical costs and indirect costs[5].

However, there is a dissonance between the magnitude of the economic impact of these infectious diseases and the number of epidemiological studies that allow the design of public health strategies based on the reality of the state of Minas Gerais. In this context, the study of the epidemiological profile of arboviruses in the Triângulo Mineiro region can provide better control of these diseases in urban areas and enable more effective monitoring and interventions in endemic regions.

Thus, this study assessed the epidemiology of Dengue, Zika and Chikungunya arboviruses in the Triângulo Mineiro region from 2014 to 2018.

METHODS

This is a cross-sectional, descriptive study with quantitative analysis. All data were obtained from the Notifiable Diseases Information System (SINAN) of the Brazilian Ministry of Health (MH).

Reported cases, confirmed cases and deaths from Dengue, Zika and Chikungunya were evaluated, which met the case definitions proposed by the MH, in the Health Surveillance Guide[6].

The cases concluded by the clinical-epidemiological and laboratory criteria for the three mosquito-borne diseases were considered as confirmed. The analysis consisted of notifications registered in SINAN from 2014 to 2018, which referred to the municipality of residence as those that compose the Triângulo Mineiro region, in the state of Minas Gerais. The database was accessed on April 6th, 2020.

The Triângulo Mineiro region concentrates approximately 7.6% of the population and contributes about 11.2% of the state's gross domestic product (GDP). The GDP per capita is the highest in the state, and the economy is primarily based on the service, logistics and agriculture sectors. The leading economic centers in the region are, respectively, Uberlândia, Uberaba, and Ituiutaba[7].

This planning region of the state of Minas Gerais comprises 35 municipalities: Água Comprida, Araguari, Araporã, Cachoeira Dourada, Campina Verde, Campo Florido, Canápolis, Capinópolis, Carneirinho, Cascalho Rico, Centralina, Comendador Gomes, Conceição das Alagoas, Conquista, Delta, Fronteira, Frutal, Gurinhatã, Indianópolis, Ipiaçu, Itapajipe, Ituiutaba, Iturama, Limeira do Oeste, Monte Alegre de Minas, Pirajuba, Planura, Prata, Santa Vitória, São Francisco de Sales, Tupaciguara, Uberaba, Uberlândia, União de Minas and Veríssimo.

For all diseases, the following variables were selected for analysis: the year of notification, evolution, municipality of residence, confirmation criteria (clinical-epidemiological, laboratory), the month of notification, age group, sex, and gestational stage.

The Tabwin 3.2 software was used for data processing and preparing thematic maps. For the tabulation and calculation of simple epidemiological

data, Microsoft® Excel® 2019 was used. Means, frequencies, incidence, mortality and lethality rates were calculated. Population estimates were used to calculate the incidence, according to the municipalities under analysis, provided by the Brazilian Institute of Geography and Statistics[8].

Ethical aspects

The study used public domain data that were analyzed in a grouped manner, not allowing the individual identification of the participants. Therefore, the approval of the Ethics Committee for Research on Human Beings and the use of the Free and Informed Consent Form are not applicable[9].

RESULTS

During analysis, 106,040 cases of Dengue, 1,691 of Zika and 421 of Chikungunya were registered. 2016 was the most expressive for Dengue and Zika in terms of absolute numbers of notifications, with 35.0% and 75.0% of cases, respectively. 2017 recorded the highest notification rate for Chikungunya, representing 42.0% of cases. Only patients affected by Dengue evolved to death, with 46 (0.08%) confirmed cases, while 11 (0.02%) evolved from other causes. Figure 1 illustrates the incidence of the three arboviruses during the analyzed period.

The average incidence of Dengue was 7.10 cases/1,000 inhabitants, where 10 municipalities had an incidence above average and all had at least one case. The year with the highest incidence was 2015 (15.31 cases/1,000 inhabitants), whereas the lowest incidence was recorded in 2017 (1.67 cases/1,000 inhabitants).

Regarding Zika, the average incidence was 0.03 case/1,000 inhabitants, where 7 municipalities had an above-average incidence, 11 had at least one case and 25 had none. The year with the highest incidence was 2016 (0.09 case/1,000 inhabitants), and 2015 showed the lowest incidence (0.001 case/1,000 inhabitants).

In the case of Chikungunya, the average incidence was the lowest among the three arboviruses – 0.009 case/1,000 inhabitants, where 10 municipalities had an incidence above average, 14 had at least one case, and 22 had none. The year with the highest incidence was 2017 (0.019 case/1,000 inhabitants). Chikungunya was detected in the region in 2015 when it registered 0.004 case/1,000 inhabitants. Therefore, in 2014, no cases were reported.

Figure 2 presents the geographic distribution of notifications and cases in the analyzed territory. When calculating the municipalities most affected by all arboviruses, in general, the following increases were observed: Água Comprida: 388.3%; Gurinhatã: 325.9%; Araporã: 266.5%; Comendador Gomes: 247.4%; and Limeira do Oeste: 236.2%. The least affected were Cascalho Rico: 4.0%; Indianópolis: 4.6%; Cachoeira Dourada: 6.0%; Monte Alegre de Minas: 6.0%; and Carneirinho: 7.8%.
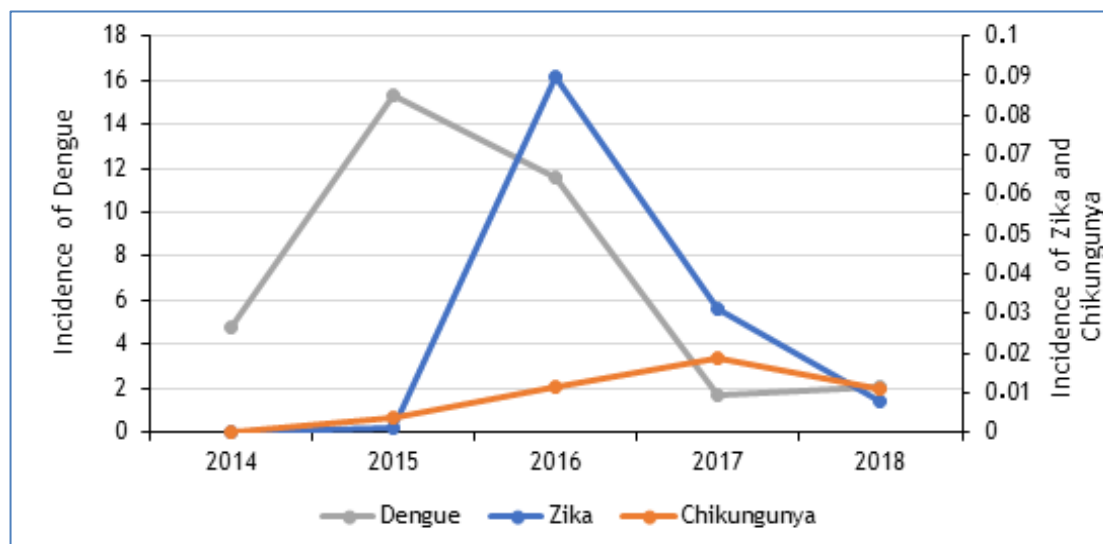

Figure 1 — Incidence per 1,000 inhabitants of notifications for Dengue, Zika and Chikungunya from 2014 to 2018, in the Triângulo Mineiro region, Minas Gerais.

Concerning the confirmation criteria, of the 57,619 confirmed cases of Dengue, 18,547 (32.2%) were confirmed by laboratory criteria, and 39,086 (67.9%) by clinical-epidemiological criteria. Of the 212 confirmed cases of Zika, 104 (49.0%) were confirmed by clinical-epidemiological criteria, 107 (50.5%) by laboratory criteria and only one was ignored/blank. Chikungunya had only 74 confirmed cases, 57 (77.0%) by laboratory criteria, and 17 (23.0%) by clinical-epidemiological

criteria. Figure 3 illustrates the frequency of the investigated arboviruses throughout the year.

Table 1 depicts the number of cases of Dengue, Zika and Chikungunya correlated with the age group and sex of the participants. The age group most affected by Dengue and Zika was 20 to 34. In turn, the age group most affected by Chikungunya was 35 to 40 years (40.5%). Notably, the findings reveal a greater involvement of the adult population compared to

children and adolescents.

Only 359 (0.6%) of the confirmed cases of Dengue affected pregnant women, totaling 97 cases in the first trimester (27.0% of the pregnant women), 113 cases in the second trimester (31.5% of the pregnant women), and 91 cases in the third trimester (25.3% of the pregnant women), whereas in 58 (16.2%) cases, the gestational age was ignored. The situation was different for Zika, because of the 212 confirmed cases, 85 (40.0%)

patients were pregnant: in the first trimester of pregnancy, 31 cases were confirmed (36.5% of the pregnant women), in the second trimester, 27 (31.8%) cases, and in the third trimester, 25 (29.4%) cases, while in 2 (2.3%) the gestational age was ignored. Of the confirmed cases of Chikungunya, only 3 (4.0%) were pregnant: the cases were equally distributed among the three gestational trimesters.
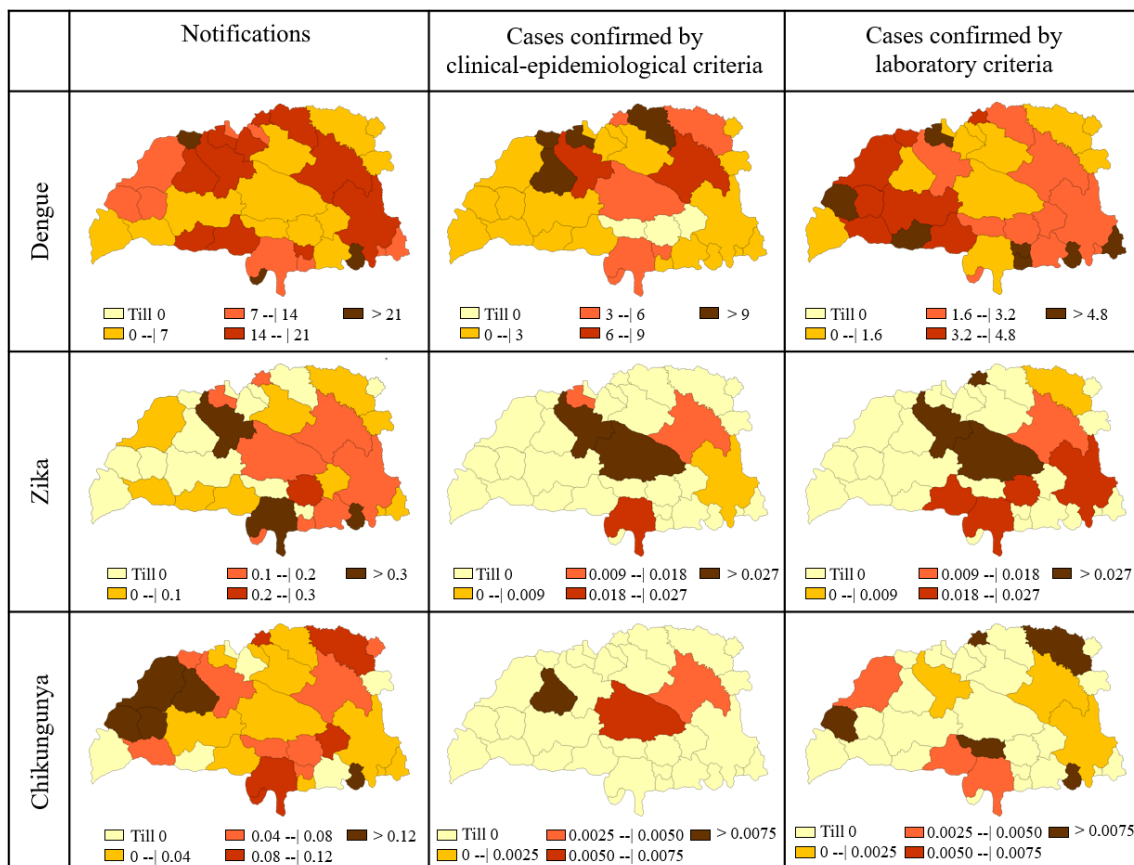

Figure 2 — Geographic distribution of notifications and confirmations of Dengue, Zika and Chikungunya per 1,000 inhabitants, according to the municipality where the cases reside.
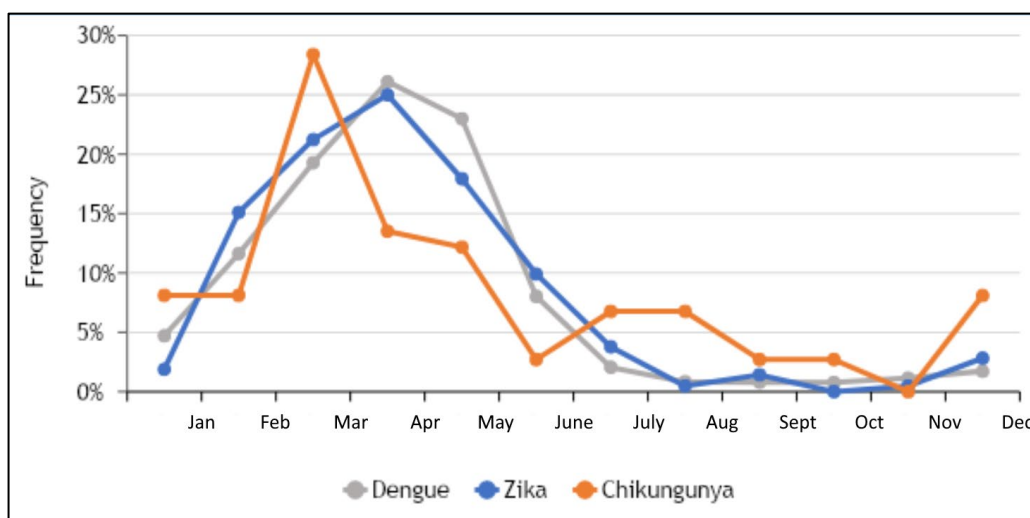

Figure 3 — Percentage of confirmed cases of Dengue, Zika and Chikungunya per month, from 2014 to 2018, according to the month of occurrence in the Triângulo Mineiro region, Minas Gerais.

Table 1 — Distribution of Dengue, Zika and Chikungunya cases, according to age group and sex, recorded in the Triângulo Mineiro region, from 2014 to 2018. Values in n (%)*.

	Dengue	Zika	Chikungunya
Age group			
<1 year	669 (1.2)	3 (1.4)	0 (0)
1-4	862 (1.5)	0 (0)	1 (1.4)
5-9	2,041 (3.5)	4 (1.9)	2 (2.7)
10-14	3,867 (6.7)	4 (1.9)	0 (0)
15-19	5,731 (10.0)	18 (8.5)	6 (8.1)
20-34	17,337 (30.1)	101 (47.6)	18 (24.3)
35-49	14,003 (24.3)	44 (20.8)	30 (40.5)
50-64	9,326 (16.2)	29 (13.7)	14 (18.9)
65-79	3,249 (5.6)	8 (3.8)	3 (4.1)
≥ 80	548 (1.0)	1 (0.5)	0 (0)
Sex			
Male	25,292 (43.9)	34 (16.0)	26 (35.1)
Female	32,312 (56.1)	178 (84.0)	48 (64.9)
Ignored/ Blank	29 (<0.1)	0 (0)	0 (0)

*n: number of cases; %: percentage for each disease and categorical variable.

DISCUSSION

The survey of the epidemiological profile of arbovirus infections in the Triângulo Mineiro region from 2014 to 2018 revealed that the period with the highest notification rates for Dengue, Zika and Chikungunya was 2016, 2016, and 2017, respectively.

Dengue had the highest number of notifications in 2015 and 2016, with 35,096 and 36,582 cases, respectively, showing a significant decrease in 2017. This result may be associated with increased public campaigns to raise awareness and combat the vector of arboviruses in 2017, besides the immunological protection of those infected in the previous years[2].

An outstanding fact of the analyzed period is that, according to Honório et al.[10], the first autochthonous CHIKV infections in Brazil were recorded in 2014, manifesting the first three cases in the region only in 2015 in the city of Uberlândia. Posteriorly, there was an increase in the number of cases, reaching a peak in 2017 with 31 confirmed cases.Similarly, ZIKV was introduced to Brazil in 2015[11], but already presented the first three cases in the same year, also in Uberlândia. However, unlike CHIKV, the peak of ZIKV was in the following year,

2016, with 143 confirmations.

Women were predominant in the profile of patients reported for Dengue, Chikungunya and Zika, totaling 56.0%, 66.0% and 73.6% of the cases, respectively. Regarding the age group, in all arboviruses, adults were the most affected. Of the DENV cases, 41.3% were between 20 and 50. The same age group presented 58.4% of notifications for CHIKV and 60.7% for ZIKV. These findings agree with previous investigations carried out in Brazil, including Oliveira et al.[12] about DENV in Fortaleza, Ceará, and Porto et al.[13] and Monteiro et al.[14] about Dengue in Teresina, Piauí.

The analysis of the region demonstrated that the incidence of arboviruses in some municipalities of the Triângulo Mineiro differed from the others, with percentages above 230%, with emphasis on Água Comprida, Araporã, Comendador Gomes, Gurinhatã and Limeira do Oeste, thereby indicating a much more significant incidence. Alternatively, some municipalities had an incidence of less than 8.0% of arboviruses, including Cachoeira Dourada, Carneirinho, Cascalho Rico, Indianópolis and Monte Alegre de Minas.

The difficulty of clinical diagnostic accuracy among arboviruses in periods of greater circulation and absence of confirmatory tests can be highlighted as a limitation of this study, which can generate margins of uncertainty regarding the real impacts of each arbovirus[15]. Furthermore, using secondary data on arboviruses may present inconsistencies related to information processing and inadequate filling of notification forms, as described by Páscoa et al.[16] when analyzing the database used in Fortaleza, Ceará.

Notwithstanding that, this study allowed to assess the information on the population profile and the municipalities most affected by Dengue, Chikungunya and Zika in a critical time frame, which can serve as a basis for managing local health services, as it guides the implementation, monitoring and evaluation of health care models, and disease prevention and control actions[17].

CONCLUSION

The analysis of the epidemiological profile of DENV, CHIKV and ZIKV in the Triângulo Mineiro from 2014 to 2018 was very similar to the profiles of other regions of Brazil. Despite the simultaneous circulation of the three arboviruses, Dengue is the major concern for the region. This study provided a detailed description of the most affected populations and municipalities, thus enabling the planning and execution of public policies to control and prevent arboviral diseases in the region under study.

REFERENCES

1. Lopes N, Nozawa C, Linhares REC. Características gerais e epidemiologia dos arbovírus emergentes no Brasil. Rev Pan-Amaz Saúde. 2014;5(3):55-64. https://doi.org/10.5123/S2176-62232014000300007
2. Donalisio MR, Freitas ARR, Von Zuben APB. Arboviruses emerging in Brazil: challenges for clinic and implications for public health. Rev Saude Publica. 2017;51:30. https://doi.org/10.1590/s1518-8787.2017051006889
3. Lima-Camara TN. Emerging arboviruses and public health challenges in Brazil. Rev Saude Publica. 2016;50:36. https://doi.org/10.1590/S1518-8787.2016050006791
4. Brasil, Ministério da Saúde. Boletim Epidemiológico no.10.

2019;50:1-13.

5. Teich V, Arinelli R, Fahham L. Aedes aegypti e sociedade: o impacto econômico das arboviroses no Brasil. J Bras Econ Saúde. 2017;9(3):267-76. https://doi.org/10.21115/JBES.v9.n3.p267-76

6. Brasil, Ministério da Saúde, Secretaria de Vigilância em Saúde. Guia de vigilância em saúde. 5ª ed. Brasília, DF: Ministério da Saúde; 2014 [cited 2022 May 30]. 126 p. Available from: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/publicacoes-svs/vigilancia/guia-de-vigilancia-em-saude_5ed_21nov21_isbn5.pdf/view

7. Associação Mineira de Municipios. Caracterização econômica das regiões de planejamento [Internet]. 2014 [cited 2022 May 30]. Available from: https://bit.ly/38S2AWv

8. Brasil, Instituto Brasileiro de Geografia e Estatística. Estimativas da População. [Internet] [cited 2022 May 30]. Available from: https://bit.ly/3z2mKYp

9. Brasil, Conselho Nacional de Saúde. Resolução no 466, de 12 de dezembro de 2012. Braslília, DF: Diário Oficial da União; 2012 [2013 Jun 13; cited 2022 May 30]. Available from: https://bit.ly/3x152Se

10. Honório NA, Câmara DCP, Calvet GA, Brasil P. Chikungunya: uma arbovirose em estabelecimento e expansão no Brasil. Cad Saude Publica. 2015;31(5):906-8. https://doi.org/10.1590/0102-311XPE020515

11. Campos GS, Bandeira AC, Sardi SI. Zika virus outbreak, Bahia, Brazil. Emerg Infect Dis 2015;21:1885-16. https://doi.org/10.3201/eid2110.150847

12. Oliveira RMAB, Araújo FMC, Cavalcanti LPG. Aspectos entomológicos e epidemiológicos das epidemias de dengue em Fortaleza, Ceará, 2001-2012. Epidemiol Serv Saude. 2018;27(1):e201704414. https://doi.org/10.5123/S1679-49742018000100014

13. Porto WL, Terto TF, Soares LC, Aguiar Cardoso AC, Castro Alencar VM, Da Silva BAK, et al. Cenário epidemiológico das arboviroses no Piauí. Rev Eletrônica Acervo Saúde. 2019;11(14):e1054. https://doi.org/10.25248/reas.e1054.2019

14. Monteiro ESC, Coelho ME, Cunha IS, Cavalcante MAS, Carvalho FAA. Aspectos epidemiológicos e vetoriais da dengue na cidade de Teresina, Piauí - Brasil, 2002 a 2006. Epidemiol Serv Saúde. 2009;18(4):365-74. https://doi.org/10.5123/S1679-49742009000400006

15. Avelino-Silva VI, Ramos JF. Arboviroses e políticas públicas no Brasil [Editorial]. Rev Ciênc Saúde. 2017;7(3):1-2. https://doi.org/10.21876/rcsfmit.v7i3.675

16. Páscoa FRB, Gonçalves NA, Magalhães AMBC, Gurgel SCV, Filizola LRM, Farias CMNE. Análise da consistência dos bancos de dados das arboviroses em uma Unidade de Saúde em Fortaleza-CE. Rev Saúd Digi Tec Edu [Internet]. 2018 [cited 2022 May 30];3(4):18-31. Available from: http://www.periodicos.ufc.br/resdite/article/view/39698

17. Brasil, Conselho Nacional de Secretários de Saúde. Vigilância em saúde: parte 2. Vol. 6, Coleção Para Entender a Gestão do SUS. Brasília: CONASS; 2011. Available from: https://bit.ly/3GAOi9a

---