# Arbovirus in transplants of solid organs and eyeball: High risk in endemic area receptors?

# Arbovírus em transplantes de órgãos sólidos e globo ocular: Alto risco em receptores de áreas endêmicas?

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**ABSTRACT**
This work is a retrospective cross-sectional analytical study that evaluated individuals transplanted from solid organs and eye balls that had infection by the Chikungunya or Zika virus and, received the organ from an asymptomatic donor. An epidemiological assessment of infection by the Chikungunya and Zika virus in Brazil, was also carried out, and an assessment of the organ and eyeball transplant situation in Brazil. Other data were obtained from the literature, carrying out a survey of articles published in the PUBMED database, from January 2015 to December 2019, which released data from case reports and retrospective and prospective studies. The symptoms most frequently associated with CHIKV are myalgia (60% - 93%), fever above 38.9 ºC (90%) and asymptomatic cases (16% -27%), which are not as frequent, but are relevant when it comes to transplants. Symptoms and signs generally associated with Zika virus infection are skin rashes (91%), fever above 38.9º C (65% -80%), in addition to asymptomatic (80%). We found that recipients of organs contaminated with CHIKV or ZIKV may have different outcomes depending on the transplanted organ. Through this evidence, people who had a recent infection or death from these arboviruses could be candidates for kidney and liver donation.

**Keywords:** Chikungunya, Zika, Transplantation, kidney, Liver.

**RESUMO**
Este trabalho é um estudo transversal analítico retrospectivo que avaliou indivíduos transplantados de órgãos sólidos e globos oculares que apresentaram infecção pelo vírus Chikungunya ou Zika e receberam o órgão de doador assintomático. Também foi realizada uma avaliação epidemiológica da infecção pelos vírus Chikungunya e Zika no Brasil e uma avaliação da situação do transplante de órgão e globo ocular no Brasil. Outros dados foram obtidos na literatura, por meio de levantamento de artigos publicados

na base de dados PUBMED, de janeiro de 2015 a dezembro de 2019, que divulgou dados de relatos de casos e estudos retrospectivos e prospectivos. Os sintomas mais frequentemente associados ao CHIKV são mialgia (60% - 93%), febre acima de 38,9 ºC (90%) e casos assintomáticos (16% -27%), que não são tão frequentes, mas são relevantes quando se trata de transplantes . Os sintomas e sinais geralmente associados à infecção pelo zika vírus são erupções cutâneas (91%), febre acima de 38,9º C (65% -80%), além de assintomáticos (80%). Descobrimos que receptores de órgãos contaminados com CHIKV ou ZIKV podem ter desfechos diferentes dependendo do órgão transplantado. Por meio dessas evidências, as pessoas que tiveram uma infecção recente ou morte por esses arbovírus podem ser candidatas à doação de rim e fígado.

**Palavras-chave:** Chikungunya, Zika, Transplantação, rim, Fígado.

## 1 INTRODUCTION

Arboviruses comprise a group of viruses that are disseminated via arthropods, usually hematophagous insects, and are considered endemic on all continents, except Antarctica [1].

Mosquitoes of the genus *Aedes* are vectors that can cause various infections, as the Chikungunya and Zika viruses. Brazil is a country of great territorial extension and populous, located in tropical and subtropical regions, in which the presence of mosquitoes of the genus *Aedes* is frequent [2]. There are no specific treatments and no vaccine against the Chikungunya and Zika viruses [3], in Brazil the use of organs from probable donor, who had recent arbovirus infection, is automatically discarded, since there are no national guidelines recommending the use of same [4]. Even though Brazil is a world reference country in transplants, with 96% of the procedures financed by the Unified Health System in 2018 throughout the country [5] and the second largest country that performs kidney and liver transplants in the world [6].

The transplanted population, deserves special attention due to immunosuppression. In addition, there is a potential risk of transmission of these arboviruses during the donation process. And the consequences of this transmission are not yet fully understood.

### 1.1 *CHIKUNGUNYA VIRUS (CHIKV)*

CHIKV belongs to the Alphavirus genus, and is transmitted via the bite of the mosquito of the genus *Aedes*, with *Aedes aegypti* being the most frequent species in the transmission of the virus [2]. The first case of infection with this virus, described in the literature, occurred in the year 1950, in Tanzania [7], subsequently, in the 1960s and

1970s decades, small outbreaks occurred over the years, as in Asia and Africa respectively [8]. In 2013 year, it appeared in the Americas and in 2014, the first virus infection indigenous case was identified [7]. In 2016, in Brazil, there were approximately 265,000-suspected cases of affected by the infection [9].

There are four types of genotypes circulating in Brazil [10]. The incubation period varies among three and seven days, the main symptoms being polyarthralgia and fever above 39 ºC [7]. However, there are other associated symptoms (Table 1). On rare occasions, they can lead to cardiovascular disorders, neurological and ocular changes and in more extreme cause death [8].

### 1.2 *ZIKA VIRUS (ZIKV)*

ZIKV belongs to the genus Flavivirus, and like CHIKV, it is transmitted via the bite of the mosquito of the genus *Aedes* [11]. The virus was first isolated from monkeys in the Zika forest- Uganda, in 1947, and later, it was isolated from humans in the regions of Micronesia (2007), Gabon (2010) and French Polynesia (2013) [12]. The first isolated case in Brazil occurred in May 2015, and in few months, more than 1.5 million people had been affected by the infection [13].

The main symptoms are mild fever, arthralgia and conjunctivitis [14], in addition to other symptoms related to the disease (Table 1). In more severe cases, other changes are observed in the infection, such as neurological complications such as Guillain-Barré syndrome, meningoencephalitis, in addition to microcephaly in neonates of women who had the infection during early pregnancy [15].

### 1.3 *CHIKUNGUNYA AND ZIKA VIRUSES IN ORGAN AND EYE GLOBE TRANSPLANTATION*

Few articles discuss the transmission of CHIKV and ZIKV via transplantation of solid organs and eyeballs. Receptor living in endemic areas have high risk of acquiring these diseases. There are few cases in the literature discussing this topic in this population [14]. Although some studies (isolated case reports) demonstrate the benign course of the disease, these infections can evolve to complications, which can lead to rejection of the transplanted organ or the death of the receptor (Table 2).

In the period from 2015 to 2019, there were 45,435 organ and eyeball transplants in Brazil (heart, liver, eyeball and kidneys) (Table 3) [16]. Moreover, in that same period, in Brazil there were 84,493 confirmed cases of infection by the CHIKV and ZIKV viruses, totaling 112 confirmed deaths (Table 4) [9].

As it does not fully understand the implications that an organ infected with these viruses can generate for the immunosuppressed receptor, the evaluation of the potential risk in the transplanted people, which received the infected organ, is necessary for the development of public policies that provide important information regarding prevention, diagnosis and treatment. In this work, we discuss the current state of knowledge about these viruses in this population that received an infected organ, as well as the prevalence and repercussion of the infection in the recipient.

## 2 MATERIAL AND METHOD

This work is a retrospective cross-sectional analytical study, that evaluated individuals transplanted from solid organs and eyeballs who had infection by the Chikungunya or Zika virus, that received the organ from an asymptomatic donor. An epidemiological assessment of infection by the Chikungunya and Zika virus in Brazil was also carried out, and an assessment of the organ and eyeball transplant situation in Brazil. These data were searched on the ABTO (Brazilian Transplantation Association) website, under the domain of the public health department. The information is publicly accessible, without the need to apply the authorization term for the development of the research. Other data were obtained from the literature, carrying out a survey of articles published in the PUBMED database, from January 2015 to December 2019, which released data from case reports and retrospective and prospective studies. The epidemiological data of the study were analyzed using the Microsoft Excel program (2010). Statistical analyzes were performed using the GraphPad Prism 5.0 program (Graphpad software, San Diego, CA, USA).

## 3 RESULTS

The Table 1 shows the main signs and symptoms associated with infections by Chikungunya and Zika viruses. The symptoms most frequently associated with CHIKV are: myalgia (60% - 93%), fever above 38.9º C (90%), conjunctivitis (77%), arthralgia (69%) and asymptomatic cases (16% -27 %), which are not much frequent, but are relevant when it comes to transplants. Symptoms and signs usually associated with Zika virus infection are skin rashes (91%), fever above 38.9 ºC (65% - 80%), headache (79%), arthralgia (65%), in addition to asymptomatic (80%), which affects most infected individuals.

**Table 1** Main clinical manifestations caused by the Chikungunya and Zika viruses

| | Symptoms / signs | References |
|---|---|---|
| Chikungunya Virus | • High fever [> 38.9º C (90%)]<br>• Skin rashes (35-50%)<br>• Retro-orbital pain (38%)<br>• Conjunctivitis (77%)<br>• Nausea (41%)<br>• Vomiting (10%)<br>• Abdominal pain (18%)<br>• Oral ulcer (16%)<br>• Myalgia (60-93%)<br>• Arthralgia (69%)<br>• Hemorrhage (4%)<br>• Headache (40 - 81%)<br>• Encephalopathy (< 0.1%)<br>• *ASYMPTOMATIC (16 - 27%)* | • [17]<br>• [13]<br>• [10]<br>• [18] |
| Zika Virus | | |
| | • High fever [> 38.9º C (65-80%)]<br>• Rash (91%)<br>• Retro-orbital pain (48%)<br>• Nausea (27%)<br>• Abdominal pain (12%)<br>• Myalgia (65%)<br>• Arthralgia (70%)<br>• Hemorrhage (6%)<br>• Headache (79%)<br>• Encephalopathy (<0.1%)<br>• Guillian-Barré syndrome (rare)<br>• Microcephaly<br>• *ASYMPTOMATIC (80%)* | • [17]<br>• [12]<br>• [19]<br>• [10] |

The Table 2 shows the main works published in the literature that address infection by the Chikungunya and Zika virus, acquired via transplantation of solid organs and eyeballs from asymptomatic donors, published among the years 2015 and 2019. According to the published data, in the last five years had nine cases of CHIKV and ZIKV infection, acquired via organ and eyeball transplantation. Of these, three kidney transplants were contaminated with CHIKV. In ZIKV infection, there is a prevalence of transplantation of two livers, two kidneys, a heart and an eyeball, all contaminated. In all solid organ transplants, their receptors had the most varied symptoms and signs. Only one receptor on the eyeball was asymptomatic.

**Table 2** Summary of cases associated with transplantation of contaminated solid organs and eyeballs in the years 2015 to 2019

| Virus | Kind of transplant | Symptoms | Diagnosis | Kind of study | References |
|---|---|---|---|---|---|
| CHIKV | Kidneys | Arthralgia, diarrhea, fever, high blood pressure, myalgia and nausea | RT-PCR IgM+ IgG+ PRNT+ | Case report | [8] |
| CHIKV | Kidneys | Arthralgia, fever and headache | IgM+ | Experimental | [7] |
| CHIKV | Kidneys | Rash, fever, malaise, arthralgia | NAT+ RT-PCR+ IgM+ | Case report | [1] |
| ZIKV | Heart | Fever, high blood pressure, malaise and meningoencephalitis | RT-PCR+ Electron Microscopy | Case report | [11] |
| ZIKV | Liver | Runny nose, high blood pressure, myalgia and cough | RT-PCR+ | Case report | [2] |
| ZIKV | Liver | Fever and myalgia | RT-PCR+ | Case report | [2] |
| ZIKV | Kidneys | Arterial hypertension, malaise and myalgia | RT-PCR+ | Case report | [2] |
| ZIKV | Kidneys | Diarrhea and vomiting | RT-PCR+ | Case report | [2] |
| ZIKV | eyeball | Asymptomatic | IgM+ IgG+ RT-PCR | Experimental | [20] |

The Table 3 shows data obtained from the Brazilian organ transplant association through annual bulletins. It contains the absolute numbers and by region of heart, liver, eyeball and kidney transplantation, that took place in Brazil among the years 2015 to 2019.

The growing number of transplants in Brazil also corresponds to the increase in eyeball transplants, which stands out with more than 10,500 transplants that occur annually. The southeastern region leads the largest number of transplants in Brazil, followed by the south. With emphasis on transplantation related to the eyeball, which had the highest number. Among the four types of transplanted organs, heart transplantation is the least frequent (Table 3).

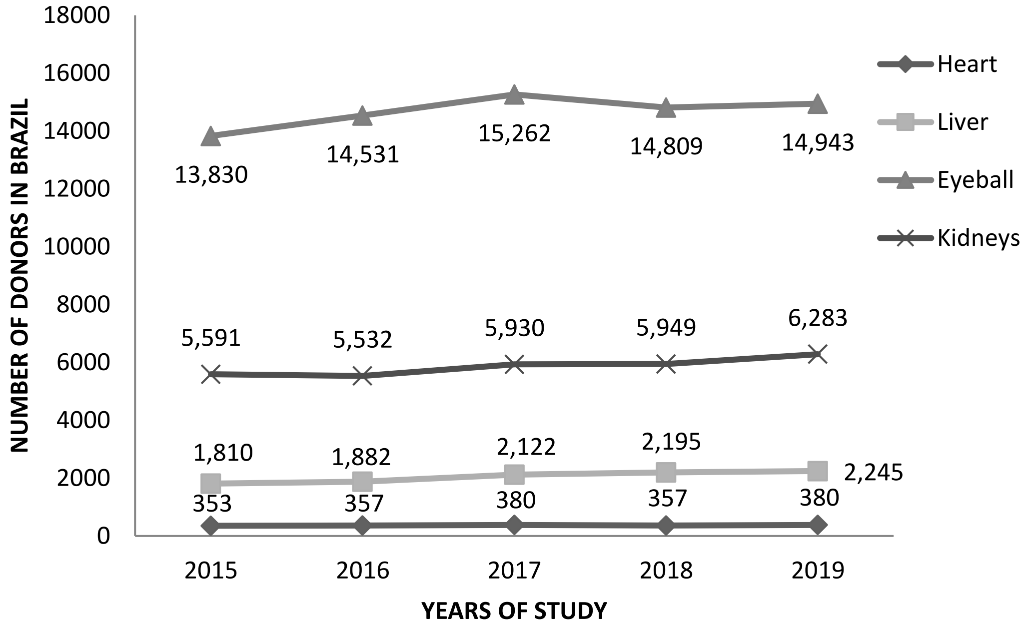
**Table 3** Number of organ donors and eyeballs by region in Brazil, in the period 2015-2019

| **Transplanted organ** | **Study period** | | | | |
|---|---|---|---|---|---|
| **Heart** | **2015** | **2016** | **2017** | **2018** | **2019** |
| Absolute number | 353 | 357 | 380 | 357 | 380 |
| Midwest | 30 | 47 | 38 | 34 | 29 |
| Northeast | 73 | 72 | 88 | 79 | 84 |
| North | 0 | 0 | 0 | 0 | 0 |
| Southeast | 193 | 178 | 188 | 192 | 213 |
| South | 57 | 60 | 66 | 52 | 54 |
| **Liver** | **2015** | **2016** | **2017** | **2018** | **2019** |

| | | | | | |
|---|---|---|---|---|---|
| Absolute number | 1.810 | 1.882 | 2.122 | 2.195 | 2.245 |
| Midwest | 62 | 76 | 86 | 91 | 96 |
| Northeast | 350 | 350 | 381 | 407 | 454 |
| North | 9 | 7 | 14 | 14 | 10 |
| Southeast | 1.000 | 935 | 1.101 | 1.114 | 1.150 |
| South | 389 | 514 | 540 | 569 | 535 |
| **Eyeball** | **2015** | **2016** | **2017** | **2018** | **2019** |
| Absolute number | 13.830 | 14.534 | 15.242 | 14.809 | 14.943 |
| Midwest | 1.579 | 1.491 | 1.871 | 1.478 | 1.276 |
| Northeast | 2.625 | 3.387 | 3.570 | 3.289 | 3.337 |
| North | 468 | 576 | 660 | 607 | 563 |
| Southeast | **6.784** | **6.754** | **7.014** | **7.516** | **7.558** |
| South | **2.374** | **2.326** | **2.127** | **1.919** | **2.209** |
| **Kidneys** | **2015** | **2016** | **2017** | **2018** | **2019** |
| Absolute number | 5.591 | 5.532 | 5.930 | 5.949 | 6.283 |
| Midwest | 172 | 199 | 206 | 252 | 326 |
| Northeast | 900 | 829 | 962 | 1.032 | 1.146 |
| North | 132 | 98 | 103 | 78 | 79 |
| Southeast | 3.132 | 3.069 | 3.003 | 3.122 | 3.345 |
| South | 1.255 | 1.337 | 1.449 | 1.465 | 1.387 |

A separate survey of the number of donors of solid organs and eyeballs in Brazil was also carried out, the data showed a stable number of donations according to the period analyzed. The results obtained are shown in Figure 1.

**Fig. 1** Number of solid organ and eyeball donors in Brazil among the years 2015 to 2019




The Table 4 shows the data acquired from the public health secretary, where it was distributed annually (2015-2019), the number of probable infections caused by the

Chikungunya and Zika viruses, the number of confirmed cases and the number of deaths that occurred in Brazil.

The years 2016 and 2017 had the highest numbers of confirmed cases of infection and deaths from CHIKV and ZIKV. The average number of confirmed cases exceeds 150,000 and more than 360 deaths from CHIKV. The profile of ZIKV infection contrasts with that of CHIKV, considering all the years of this study, the numbers of confirmed cases are below 10,000, except in the year 2016, in which the number of infections exceeded 130,000 confirmed cases, with at most eight deaths.

**Table 4** Number of probable, confirmed cases and deaths from the Chikungunya and Zika viruses in Brazil among the years 2015 to 2019

| | CHIKUNGUNYA | | | ZIKA | | |
|---|---|---|---|---|---|---|
| **YEAR** | **Probable cases** | **Confirmed cases** | **Deaths** | **Probable cases** | **Confirmed cases** | **Deaths** |
| **2015** | 38.499 | 17.971 | 14 | 37.011 | 18 | 3 |
| **2016** | **277.882** | **151.318** | **196** | **216.207** | **130.701** | **8** |
| **2017** | 185.737 | 151.966 | 173 | 17.452 | 8.839 | 2 |
| **2018** | 87.687 | 68.962 | 39 | 8.680 | 3.984 | 5 |
| **2019** | 132.205 | 63.854 | 92 | 10.768 | 2.650 | 3 |

The higher concentration of cases in the northeast can be justified by being the second highest population density in relation to the other regions of the country and being an endemic region (Table 5).

**Table 5** Number of Brazil's population by region among 2015 to 2019

| POPULATION | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Midwest | 15.219.608 | 15.442.232 | 15.660.988 | 15.875.907 | 16.085.885 |
| Northeast | 56.186.190 | 56.560.081 | 56.915.936 | 57.254.159 | 56.760.780 |
| North | 17.231.027 | 17.472.636 | 17.707.783 | 17.936.201 | 18.182.253 |
| Southeast | **85.115.623** | **85.745.520** | **86.356.952** | **86.949.714** | **87.711.946** |
| South | 29.016.114 | 29.230.180 | 29.439.773 | 29.664.948 | 29.754.036 |

Population data from Brazil, by region, was analyzed, within the studied period and the data showed that the northeast region was the one with the highest number of cases (Tables 6A and 6B). The Table 6A describes the probable cases and incidence of CHIKV by region in 2016 and 2017. In both years, the Northeast region leads the cases of infection by the Chikungunya virus with the highest incidences, followed by the Southeast region. The southern region had a lower frequency of cases in both years.

**Table 6a** Number of probable cases and Chikungunya incidence (by 100 thousand inhabitants) by region and Federation Unit, Brazil, 2016 and 2017

| **Region / Federation Unit** | **Cases (n)** | | **Incidence** (/ 100 thousand inhab.) | |
|---|---|---|---|---|
| | **2016** | **2017** | **2016** | **2017** |
| **North** | **9.019** | **16.570** | **50,9** | **90,7** |
| Rondônia | 829 | 222 | 46,4 | 12,4 |
| Acre | 372 | 115 | 45,5 | 14,1 |
| Amazonas | 878 | 244 | 21,9 | 6,1 |
| Roraima | 240 | 4.088 | 46,7 | 795,0 |
| Para | 4.343 | 8.505 | 52,5 | 102,8 |
| Amapá | 967 | 221 | 123,6 | 28,3 |
| Tocantins | 1.390 | 3.175 | 90,7 | 207,1 |
| **Northeast** | **239.714** | **142.131** | **421,2** | **249,7** |
| Maranhão | 13.853 | 6.416 | 199,2 | 92,3 |
| Piauí | 2.779 | 6.358 | 86,5 | 197,9 |
| Ceara | 48.324 | 113.927 | 539,1 | 1.271,0 |
| Rio Grande do Norte | 24.927 | 2.082 | 717,3 | 59,9 |
| Paraíba | 20.289 | 1.675 | 507,3 | 41,9 |
| Pernambuco | 50.139 | 1.933 | 532,8 | 20,5 |
| Alagoas | 18.451 | 520 | 549,3 | 15,5 |
| Sergipe | 9.268 | 401 | 409,0 | 17,7 |
| Bahia | 51.684 | 8.819 | 338,3 | 57,7 |
| **Southeast** | **25.245** | **22.984** | **29,2** | **26,6** |
| Minas Gerais | 1.452 | 16.771 | 6,9 | 79,9 |
| Espírito Santo | 470 | 841 | 11,8 | 21,2 |
| Rio de Janeiro | 18.516 | 4.288 | 111,3 | 25,8 |
| São Paulo | 4.807 | 1.084 | 10,7 | 2,4 |
| **South** | **1.978** | **373** | **6,7** | **1,3** |
| Paraná | 1.058 | 229 | 9,4 | 2,0 |
| Santa Catarina | 578 | 70 | 8,4 | 1,0 |
| Rio Grande do Sul | 342 | 74 | 3,0 | 0,7 |
| **Midwest** | **1.926** | **3.679** | **12,3** | **23,5** |
| Mato Grosso do Sul | 284 | 168 | 10,6 | 6,3 |
| Mato Grosso | 568 | 3.154 | 17,2 | 95,4 |
| Goiás | 486 | 227 | 7,3 | 3,4 |
| Distrito Federal | 588 | 130 | 19,7 | 4,4 |
| **TOTAL** | **277.882** | **185.737** | **134,8** | **90,1** |

The Table 6B describes the probable cases and incidence of ZIKV by region in 2016 and 2017. In 2016, the Southeast region had the highest numbers of cases of CHIKV infection and the highest incidences, followed by the Northeast region. In 2017, the Midwest region had the highest infection rates, followed by the Northeast region. The South region had a lower number of infection cases in both years.

**Table 6b** Number of probable cases and Zika incidence (by 100 thousand inhabitants) by region and Federation Unit, Brazil, 2016 and 2017.

| **Region / Federation Unit** | **Cases (n)** | | **Incidence** (/ 100 thousand inhab) | |
|---|---|---|---|---|
| | **2016** | **2017** | **2016** | **2017** |
| **North** | **12.861** | **2.201** | **72,6** | **12,4** |
| Rondônia | 923 | 141 | 51,6 | 7,9 |
| Acre | 79 | 40 | 9,7 | 4,9 |
| Amazonas | 4.485 | 429 | 112,1 | 10,7 |
| Roraima | 169 | 203 | 32,9 | 39,5 |
| Para | 4.664 | 688 | 56,4 | 8,3 |
| Amapá | 405 | 11 | 51,8 | 1,4 |
| Tocantins | 2.136 | 689 | 139,3 | 44,9 |
| **Northeast** | **75.338** | **5.270** | **132,4** | **9,3** |
| Maranhão | 4.608 | 516 | 66,3 | 7,4 |
| Piauí | 236 | 154 | 7,3 | 4,8 |
| Ceara | 4.340 | 1.503 | 48,4 | 16,8 |
| Rio Grande do Norte | 3.699 | 460 | 106,4 | 13,2 |
| Paraíba | 3.750 | 115 | 93,8 | 2,9 |
| Pernambuco | 445 | 39 | 4,7 | 0,4 |
| Alagoas | 6.827 | 249 | 203,2 | 7,4 |
| Sergipe | 217 | 17 | 9,6 | 0,8 |
| Bahia | 51.216 | 2.217 | 335,3 | 14,5 |
| **Southeast** | **92.937** | **3.732** | **107,6** | **4,3** |
| Minas Gerais | 13.865 | 758 | 66,0 | 3,6 |
| Espírito Santo | 2.333 | 352 | 58,7 | 8,9 |
| Rio de Janeiro | 71.529 | 2.210 | 430,0 | 13,3 |
| São Paulo | 5.210 | 412 | 11,6 | 0,9 |
| **South** | **898** | **93** | **3,1** | **0,3** |
| Paraná | 661 | 61 | 5,9 | 0,5 |
| Santa Catarina | 69 | 20 | 1,0 | 0,3 |
| Rio Grande do Sul | 168 | 12 | 1,5 | 0,1 |
| **Midwest** | **34.173** | **6.156** | **218,2** | **39,3** |
| Mato Grosso do Sul | 1.722 | 76 | 64,2 | 2,8 |
| Mato Grosso | 21.628 | 2.148 | 654,3 | 65,0 |
| Goiás | 10.477 | 3.867 | 156,5 | 57,8 |
| Distrito Federal | 346 | 65 | 11,6 | 2,2 |
| **TOTAL** | **216.207** | **17.452** | **104,9** | **8,5** |

## 4 DISCUSSION

Currently, there are numerous cases of indigenous CHIKV transmissions in Brazil, mainly in the northeast region, as it is an endemic region and the second most populous region in Brazil. In contrast to these data, ZIKV infection is less frequent, as it is a punctual outbreak in certain seasons. In both cases, as of 2017, Brazil has seen a decrease in the number of confirmed cases of these infections [9].

The main form of transmission of CHIKV and ZIKV is the vector pathway, however, in the literature there are cases where transmission occurred through blood transfusion [21] or less frequently by contaminated solid organ transplants [2], in addition to other transmission routes [4].

In the last five years (2015 to 2020), only nine works related infection via transplantation of contaminated organs have been reported worldwide, that the receptor received the transplant from an asymptomatic donor and developed the infection [11]. The symptoms were mild to moderate and a fatal case, in this case, the heart receptor infected with ZIKV developed, among other symptoms, meningoencephalitis [11]. Among the cases described in the literature, only the eyeball receptor had no symptoms [20].

For the proper functioning of the transplanted organ and, to decrease the chances of rejection, patients use immunosuppressive drugs; however, there is a duality as to the effects of using these drugs (Hall, 2009). Would these drugs have the primary effect of preventing only organ rejection and minimizing the risk of worsening the disease, or as side and unwanted effect, would they allow the development of serious infectious forms and, increase the risk of complications and rejections of transplanted organs [22].

Studies in a population with liver and kidney transplantation, that had vectorial infection, years after transplantation, showed the course of infection similar to patients who received the contaminated organs and, non-transplanted patients without any organ involvement or deaths, due to critical complications [18, 19, 23, 24]. The above statement suggests that the prolonged use of immunosuppressants, does not favor the immunopathogenesis of the infection and, that in this case, the drug has only a protective effect.

The current situation is complex, because there are no vaccines available so far and, no specific treatments against these arboviruses. For this reason, routine screening of CHIKV and ZIKV by serology and, research of virus genetic material, are important and recommended for any potential organ donor with a history of possible exposure, whether in endemic areas such as Brazil or non-endemic areas.

We found that recipients of organs contaminated with CHIKV or ZIKV may have different outcomes, depending on the transplanted organ. Contaminated heart and eyeball receptors are more likely to develop critical complications, transplant rejection, or death. In contrast, liver and kidney transplant receptors (even with tropism and viral persistence), developed the disease with mild symptoms, without any complications for the organ receptor.

Through this evidence, people who had a recent infection or death from these arboviruses, could be candidates for kidney and liver donation, without compromising the receptors lives and the recipients would be monitored, with the aim of observing whether they would develop the disease or not.

After confirmation with new studies, they could draft new national guidelines, recommending the use of liver and kidneys from potential donors who had a recent infection or death from Chikungunya or Zika.

## COMPLIANCE WITH ETHICAL STANDARDS


## DECLARATION OF THE FINANCIAL SUPPORT

The authors declare that the manuscript entitled "**Arbovirus in transplants of solid organs and eye globe: High risk in endemic area receptors?"** did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. For aim this declaration, the corresponding author "**Paulo Alex**" is signing this document.


## DECLARATION CONFLICT OF INTEREST

The authors declare that the manuscript entitled " **Arbovirus in transplants of solid organs and eye globe: High risk in endemic area receptors?**" have no conflict of interest in this section.

For aim this declaration, the corresponding author "**Paulo Alex**" is signing this document.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Not applicable


## ETHICAL APPROVAL:

The authors declare that the manuscript entitled "**Arbovirus in transplants of solid organs and eye globe: High risk in endemic area receptors?"** it does not require approval from the ethics committee because it is public data not normally available on specific public health websites. According to Brazilian legislation **RESOLUTION No. 466, OF DECEMBER 12, 2012**, there is no need for approval by the ethics committee for the current work. For aim this declaration, the corresponding author "**Paulo Alex**" is signing this document.

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