Epidemiological Report

Hantavirus

Historic Series 2010 – 2021

Fabiana Tavares Vesgueiro, Roberta Maria Fernandes Spinola

Division of Vector-Transmitted Diseases and Anthropozoonoses
Epidemiological Surveillance Center "Prof. Alexandre Vranjac"
Disease Control Coordination
Sao Paulo State Health Department

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Correspondence
E-mail: dvzoo@saude.sp.gov.br
Instituição: ESC|DCC/SHD-SP
Endereço: Av. Dr. Arnaldo, 351 - 6th floor. CEP: 01246-000. Sao Paulo-SP, Brazil

BRIEF HISTORY

Hantaviruses are emerging zoonotic diseases transmitted mainly by inhalation of aerosols formed by the drying of urine, feces and saliva of small wild rodents infected by hantavirus. In the Americas, it manifests itself in different forms, from nonspecific acute febrile illness to more severe and characteristic pulmonary and cardiovascular conditions, which may progress to respiratory distress syndrome (ARDS). In South America, an important cardiac involvement was observed, which became known as Hantavirus Cardiopulmonary Syndrome (HCPS).

The first record of the disease in Brazil occurred in November 1993, in the region of Juquitiba, in the state of São Paulo (SSP).[1] Subsequently, it was diagnosed in several Brazilian states, with records in all regions of the country. South, Southeast and Midwest concentrate the highest percentage of confirmed cases. As they mostly occur in rural areas and in occupations related to agriculture. The average case fatality rate is approximately 40% and most patients require hospital care.[2]

ETIOLOGIC AGENT

The causative agent of hantavirus is a spherical and enveloped virus, consisting of single-stranded RNA that belongs to the genus *Orthohantavirus*, family Hantaviridae. Members of this genus can be simply called hantavirus, being transmitted between rodent mammals, marsupials and bats. The genus had 36 species recognized in 2019.[3]

In Brazil, so far, there are seven variants associated with cases of HCPS: Araraquara, Juquitiba/Araucária, Castelo dos Sonhos, Anajatuba, Laguna Negra, Paranoá and Rio Mamoré; and three identified only in rodents, whose pathogenicity is unknown.[4,5] In São Paulo, the two variants of circulating hantaviruses are Juquitiba and Araraquara. Each agent infects a rodent species; its nomenclature, in general, derives from the region where it was first identified.

RESERVOIR

Wild rodents are the main reservoirs of hantavirus. Among them, transmission occurs horizontally (by biting between specimens and aspiration of aerosols containing viral particles) and non-lethal. Thus, infected animals can play the role of reservoir for long periods, probably for life.[6]

In São Paulo there are two main species of reservoir wild rodents. The rodent *Necromys lasiurus*, whose associated hantavirus is the Araraquara variant, is widely distributed in the Cerrado and Caatinga

environments. *Oligoryzomys nigripes*, the reservoir of the Juquitiba virus, is present in the Atlantic Forest areas.[7]

TRANSMISSION MODE

Human infection most often occurs by inhalation of aerosols, formed from the urine, feces and saliva of infected rodents. Other forms of transmission to humans have also been described, but they are infrequent: percutaneous, through skin abrasions or rodent bites; contact of the virus with mucosa (conjunctival, mouth or nose), by hands contaminated with rodent excreta; person-to-person reported sporadically in Argentina and Chile, always associated with Andes hantavirus.[6]

INCUBATION AND TRANSMISSION PERIOD

The incubation period is on average from 1 to 5 weeks, with a range from 3 to 60 days.

The transmissibiliy period of hantavirus in human is unknown. Studies suggest that the highest viremia would be a few days before the appearance of signs/symptoms.

CLINICAL MANIFESTATIONS, DIAGNOSIS AND TREATMENT

In its classic form, HCPS can evolve into four distinct phases: prodromal, cardiopulmonary, diuretic and convalescent. Thus, the correct diagnosis of the disease must follow all the steps of the criteria recommended by the Ministry of Health, namely, specific clinical diagnosis for each phase of HCPS, specific and differential laboratory diagnosis and observation of the facilitating elements for early differential diagnosis in the prodromal and cardiopulmonary phases.[6,8]

For the clinical diagnosis of cardiopulmonary syndrome in patients with a compatible condition, exposure and risk should be considered, emphasizing the epidemiological history of possible contact with the reservoirs and their excreta and secretions. In the absence of specific clinical data, antecedents such as the patient's region of origin, activities or their stay in risk environments may suggest elements for the diagnosis.[6]

There is no treatment with hantavirus-specific antiviral drugs. Every suspected case of HCPS should be removed to an intensive care unit (ICU) as soon as possible[8]. During the clinical management of the patient, all specific guidelines for each stage of disease evolution recommended by the Ministry of Health must be observed.[6,8]

CIRCUMSTANCES AND/OR FACTORS DETERMINING THE OCCURRENCE OF THE DISEASE

In general, agricultural, domestic or leisure activities, directly or indirectly associated with exposure to rodents and/or their excreta, are the main risk factors for hantavirus infections. However, human cases of cardiopulmonary syndrome are also related to the biology of wild rodents, especially when the population density of these animals increases, which varies according to the seasons and results from factors such as interspecies competition, climate change, predation and breeding period.[6]

The precarious living and housing conditions in rural areas and the suburbanization of cities are also related to the transmission of the virus in Brazil. In addition to natural phenomena, for example, the flowering of bamboos, inadequate management of the environment, such as deforestation for disorderly occupation of the soil, and changes in ecosystems caused by economic development, including road and hydroelectric plants, can contribute to the occurrence of cases or outbreaks.[6] These factors occur both in isolation and together, making the epidemiology of hantavirus disease complex.

In the SSP, some examples of these circumstances that lead to the occurrence of hantavirus are: the rat-like phenomenon, agricultural activities, signal grass harvesting, inadequate construction, urban growth, deforestation/tree cutting and domestic or leisure activities.

ENVIRONMENTAL PRESERVATION

One of the ways to control or reduce the risks of hantavirus outbreaks is environmental preservation. Thus, the high diversity of rodent species can be maintained, which acts as a barrier to the spread of zoonoses. In altered environments, the diversity of species decreases and those considered generalist/opportunist can be favored, allowing the increase of their population densities and the dispersion to rural and peridomestic areas.[6]

EPIDEMIOLOGICAL SURVEILLANCE AND ECOEPIDEMIOLOGICAL/ENVIRONMENTAL SURVEILLANCE

Hantavirus is a disease of immediate compulsory notification and mandatory investigation. In any suspected case, the notification must be registered in the Notifiable Diseases Information System (Sinan), by completing and sending the disease investigation form.

Epidemiological surveillance aims to detect early cases and/or outbreaks, reduce lethality, identify risk factors associated with the disease, and recommend prevention and control measures.[6] Eco-epidemiological/environmental surveillance, on the other hand, aims to carry out activities at the probable site of infection (PSI) of human cases of HCPS to identify the prevalent rodent species and, among them, determine the probable reservoir and the circulating hantavirus variant[6]. For the prevention of the disease to be carried out satisfactorily, all stages of both surveillances recommended by the Ministry of Health must be respected.

EPIDEMIOLOGICAL SITUATION

A descriptive analysis of the information contained in the epidemiological investigation sheets of confirmed cases of hantaviruses residing in the SSP and in the Sinan database was carried out, with onset of symptoms in the period from January 2010 to December 2021.

In 2020 and 2021, however, there was no confirmation of hantavirus cases due to the lack of specific laboratory tests for the disease, a situation that occurred throughout the country, not only in the SSP. Thus, at the beginning of 2022, the Adolfo Lutz Institute restarted PCR tests for suspected cases and will carry out the exam for those pending in the previous two years.

In view of the above, the epidemiological assessment of hantavirus disease presented in this bulletin refers to the period from 2010 to 2019. Thus, there were 129 confirmed cases of the disease in São Paulo, distributed among 18 epidemiological surveillance groups (ESG), considering the probable site of infection. A higher frequency of cases was observed in the ESG of Ribeirão Preto, followed by the ESG of Marília, Presidente Venceslau and Araraquara (Table 1).

Table 1. Confirmed cases of hantavirus disease according to ESG and municipality of infection, by year of onset of symptoms, SSP, 2010 to 2019.*

ESG\municipality of infection	Year of onset of symptoms										Total
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
ESG VIII MOGI DAS CRUZES	0	1	0	0	0	1	0	0	0	0	**2**
Ferraz de Vasconcelos	0	0	0	0	0	1	0	0	0	0	**1**
Mogi das Cruzes	0	1	0	0	0	0	0	0	0	0	**1**
ESG IX FRANCO DA ROCHA	0	0	1	0	0	0	0	0	0	0	**1**
Mairiporã	0	0	1	0	0	0	0	0	0	0	**1**
ESG X OSASCO	0	0	0	0	0	0	0	1	0	0	**1**
Cotia	0	0	0	0	0	0	0	1	0	0	**1**
ESG XI ARAÇATUBA	1	0	0	0	2	0	0	0	0	0	**3**
Birigui	0	0	0	0	2	0	0	0	0	0	**2**
Mirandópolis	1	0	0	0	0	0	0	0	0	0	**1**
ESG XII ARARAQUARA	2	1	4	1	1	1	2	0	1	0	**13**
Araraquara	1	1	2	1	0	0	0	0	0	0	**5**
Gavião Peixoto	0	0	0	0	0	0	1	0	0	0	**1**
Matão	0	0	1	0	1	0	1	0	1	0	**4**
Motuca	0	0	1	0	0	0	0	0	0	0	**1**
São Carlos	1	0	0	0	0	0	0	0	0	0	**1**
Tabatinga	0	0	0	0	0	1	0	0	0	0	**1**
ESG XIII ASSIS	0	0	0	0	1	0	0	1	0	0	**2**
Assis	0	0	0	0	0	0	0	1	0	0	**1**
Borá	0	0	0	0	0	0	0	0	0	0	**0**
Paraguaçu Paulista	0	0	0	0	1	0	0	0	0	0	**1**
ESG XIV BARRETOS	0	0	1	0	0	0	0	0	0	0	**1**
Guaraci	0	0	1	0	0	0	0	0	0	0	**1**
Jaborandi	0	0	0	0	0	0	0	0	0	0	**0**
ESG XV BAURU	0	0	0	1	0	0	1	2	1	0	**5**
Itapuí	0	0	0	0	0	0	0	0	1	0	**1**
ESG XV BAURU	0	0	0	1	0	0	1	2	1	0	**5**
Itapuí	0	0	0	0	0	0	0	0	1	0	**1**
Jaú	0	0	0	0	0	0	1	0	0	0	**1**
Macatuba	0	0	0	1	0	0	0	2	0	0	**3**

GVE \município de infecção / ESG\municipality of infection	Ano de início de sintomas / Year of onset of symptoms														Total
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019					
ESG XVI BOTUCATU	0	0	0	0	0	0	0	0	0	0					0
GVE VIII MOGI DAS CRUZES	0	1	0	0	0	0	1	1	0	0					3
Botucatu	0	0	0	0	0	0	1	0	1	0					2
Ferraz de Vasconcelos	0	0	0	0	0	0	1	0	1	0					2
Cerqueira César	0	0	0	0	0	0	0	0	0	0					0
Mogi das Cruzes	0	1	0	0	0	0	1	0	0	0					2
ESG XVII CAMPINAS	0	2	1	0	0	0	0	0	0	0					3
GVE XX FRANCO DA ROCHA	0	0	1	0	0	0	0	0	0	0					1
Mairiporã	0	1	0	0	0	0	0	0	0	0					1
Campinas	0	1	0	1	0	0	0	0	0	0					2
GVE XIX CASCO	0	1	0	0	0	0	0	1	0	0					2
Cotia	0	2	0	0	0	0	0	1	0	0					3
ESG XVIII FRANCA	0	2	0	0	0	0	0	0	0	0					2
GVE XI ARAÇATUBA	1	1	0	0	0	2	0	0	0	0					4
Franca	1	0	0	0	0	0	0	0	0	0					1
Birigui	0	0	0	0	0	2	0	0	0	0					2
Miguelópolis	0	0	0	0	0	0	0	0	0	0					0
Mirandópolis	1	1	0	0	0	0	0	0	0	0					2
São José da Bela Vista	1	0	0	0	0	0	0	0	0	0					1
GVE XII ARARAQUARA	2	1	2	2	1	1	1	2	0	1					13
ESG XIX MARILIA	1	1	4	1	0	0	1	4	3	1					16
Araraquara	1	0	2	0	1	0	0	0	0	0					4
Adamantina	0	1	0	0	0	0	0	1	0	0					2
Gavião Peixoto	0	0	0	0	0	0	0	0	0	0					0
Arco-Íris	0	0	0	0	0	0	0	1	0	0					1
Matão	0	0	1	0	0	1	0	0	1	0					3
Bastos	0	0	0	0	0	0	0	1	0	0					1
Motuca	0	0	1	0	0	0	0	0	0	0					1
Echaporã	0	0	0	0	0	0	0	1	0	0					1
São Carlos	1	0	0	0	0	0	0	0	0	0					1
Flórida Paulista	0	0	0	1	0	0	0	0	0	0					1
Tabatinga	0	0	0	0	0	1	0	0	0	0					1
Lucélia	0	1	0	1	0	0	0	0	0	0					2
GVE XIII ASSIS	0	0	0	0	1	0	0	1	0	0					2
Oscar Bressane	0	0	1	0	0	0	0	0	1	0					2
Assis	0	0	0	0	0	0	0	1	0	0					1
Osvaldo Cruz	0	0	0	0	0	0	1	0	0	0					1
Borá	0	0	0	0	0	0	0	0	0	0					0
Pacaembu	0	0	1	0	0	0	0	0	0	0					1
Paraguaçu Paulista	0	0	0	0	1	0	0	0	0	0					1
Quintana	0	0	0	0	0	0	0	1	0	1					2
GVE XIV BARRETOS	0	0	1	0	0	0	0	0	0	0					1
Tupã	0	0	0	0	0	0	0	1	0	0					1
Guaraci	0	0	1	0	0	0	0	0	0	0					1
ESG XX PIRACICABA	0	1	0	0	0	0	0	0	0	0					1
Jaborandi	0	0	0	0	0	0	0	0	0	0					0
Santa Cruz da Conceição	0	1	0	0	0	0	0	0	0	0					1
GVE XV BAURU	0	0	0	0	1	0	0	1	0	0					2
ESG XXI PRESIDENTE PRUDENTE	0	1	0	0	0	0	2	0	0	0					3
Itapuí	0	0	0	0	0	0	0	0	1	0					1
GVE XV BAURU	0	0	0	0	1	0	0	1	0	0					2
Ipeê	0	0	0	0	1	0	0	1	0	0					2
Martinópolis	0	1	0	0	0	0	0	0	1	0					2
Itapuí	0	0	0	0	0	0	0	0	1	0					1
ESG XXII PRESIDENTE VENCESLAU	0	5	2	0	0	2	0	0	0	1					10
Iaú	0	0	0	0	0	0	0	1	1	1					3
Marabá Paulista	0	4	0	0	1	0	0	0	0	1					6
Mirante do Paranapanema	0	0	0	0	0	0	0	1	0	0					1
Junqueirópolis		0	2	0	1		0		0		0	0	0	0	3
Nova Guataporanga		0	0	0	0		0		0		0	0	0	0	1
Panorama	0	0	0	0	0	0	1	0	0	0					1
Paulicéia	0	1	0	0	0	0	0	1	0	0					2

GVE \município de infecção / ESG\municipality of infection	Ano de início de sintomas / Year of onset of symptoms										Total
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	

ESG\municipality of infection	Year of onset of symptoms										Total
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Tupi Paulista	0	0	0	0	0	0	2	0	0	0	**2**
ESG XXIII REGISTRO	0	1	0	0	0	1	1	1	0	0	**4**
Barra do Turvo	0	0	0	0	0	0	1	0	0	0	**1**
Cajati	0	0	0	0	0	1	0	0	0	0	**1**
Eldorado	0	1	0	0	0	0	0	0	0	0	**1**
Registro	0	0	0	0	0	0	0	1	0	0	**1**
ESG XXIV RIBEIRÃO PRETO	9	9	3	5	5	1	3	0	2	1	**38**
Barrinha	1	0	1	0	0	0	1	0	0	0	**3**
Cravinhos	1	1	0	0	0	0	0	0	0	0	**2**
Guariba	1	1	0	0	0	0	0	0	0	0	**2**
Jaboticabal	0	0	0	1	0	0	0	0	0	0	**1**
Luís Antônio	0	0	0	1	0	0	0	0	0	0	**1**
Monte Alto	0	0	0	0	1	0	0	0	0	0	**1**
Pontal	1	1	1	0	0	0	2	0	0	0	**5**
Ribeirão Preto	2	2	0	1	1	0	0	0	0	0	**6**
Santa Rosa de Viterbo	0	1	0	0	0	0	0	0	0	0	**1**
Santo Antônio da Alegria	0	0	0	0	0	0	0	0	1	0	**1**
São Simão	0	0	0	1	0	0	0	0	0	0	**1**
Serrana	0	0	0	0	1	0	0	0	0	0	**1**
Sertãozinho	3	3	1	1	2	1	0	0	1	1	**13**
ESG XXVI SÃO JOÃO DA BOA VISTA	0	2	0	0	0	0	0	0	0	0	**2**
Mococa	0	2	0	0	0	0	0	0	0	0	**2**
Other state	0	0	0	0	0	0	0	0	0	1	**1**
Blank	0	2	1	6	2	1	0	2	2	0	**16**
Total	**24**	**21**	**12**	**15**	**13**	**8**	**15**	**10**	**7**	**4**	**129**

*Dados provisórios extraídos em 11 de julho de 2022. Fonte: Divisão de Zoonoses/CVE/CCD/SES-SP.

Of the 129 confirmed cases, 74% were male (95 cases) and 26% were female (34 cases), with the most frequent ages being from 35 to 49 years and from 20 to 34 years, in both sexes, productive age groups of young adults and adults (Table 2).

Table 2.Frequency of confirmed cases of hantavirus by age group and sex, SSP, 2010 to 2019.

Age group	Sex		Total
	Male	female	
<1 Ano	0	0	**0**
1-4	0	0	**0**
5-9	0	0	**0**
10-14	1	0	**1**
15-19	5	0	**5**
20-34	31	17	**48**
35-49	41	13	**54**
50-64	14	4	**18**
65-79	3	0	**3**
80 e+	0	0	**0**
Total	**95**	**34**	**129**

*Provisional data extracted on July 11, 2022. Source: Division of Zoonoses/CVE/CCD/SES-SP.

Regarding the evolution of the total calculated (129), cure occurred in only 49 cases. In one of them the evolution is blank and 79 died, resulting in a lethality of 61% (Table 3).

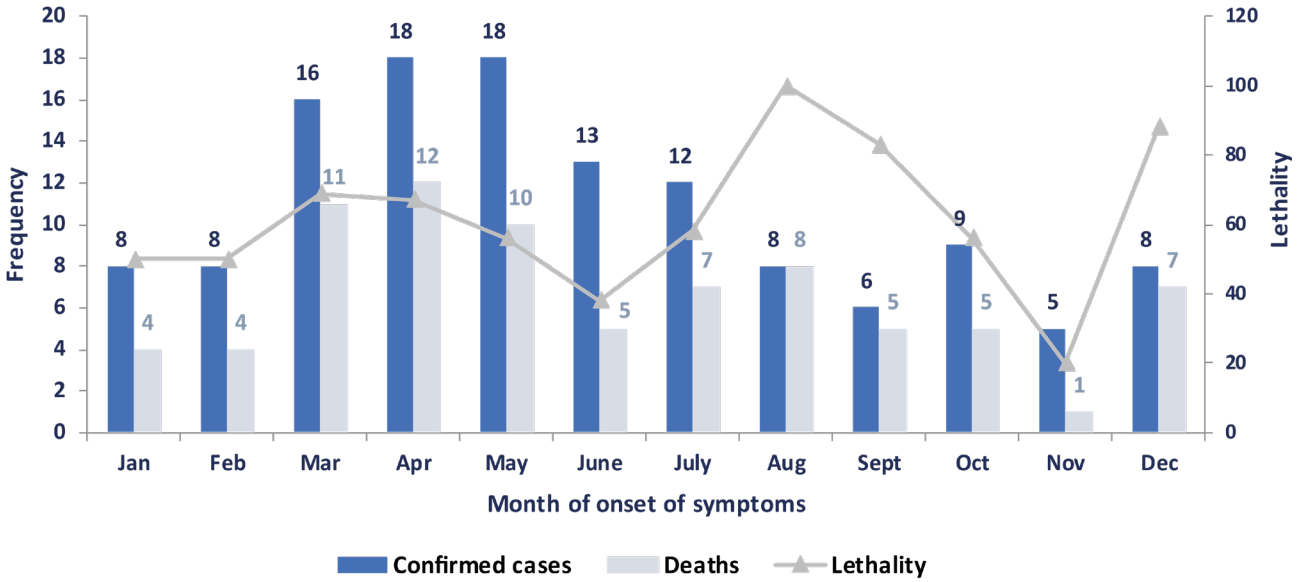
Table 3.Distribution of confirmed cases of hantavirus by evolution by year of onset of symptoms, SSP, 2010 to 2019.*

Start year of symptoms	Evolution			Total
	Cure	Death	Ignored/Blank	
2010	12	12	0	**24**
2011	5	16	0	**21**
2012	5	7	0	**12**
2013	7	8	0	**15**
2014	7	6	0	**13**
2015	2	5	1	**8**
2016	5	10	0	**15**
2017	1	9	0	**10**
2018	4	3	0	**7**
2019	1	3	0	**4**
Total	**49**	**79**	**1**	**129**

*Provisional data extracted on July 11, 2022. Source: Division of Zoonoses/CVE/CCD/SES-SP.

Graph 1 shows the distribution of confirmed cases, deaths and lethality by month of onset of symptoms, from 2010 to 2019.The months with the highest number of cases were April and May, followed by March, June and July. The most lethal were August and September, followed by March and April.

Graph 1. Frequency of confirmed cases, deaths and lethality of hantavirus by month of onset of symptoms, SSP, 2010 to 2019.*



*Provisional data extracted on July 11, 2022. Source: Division of Zoonoses/CVE/CCD/SES-SP.

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