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Analysis of epidemiological variables and completeness of yellow fever notifications in the state of Mato Grosso do Sul, Brazil

Análise das variáveis epidemiológicas e da completude das notificações de febre amarela no estado de Mato Grosso do Sul, Brasil

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ABSTRACT

Introduction: Yellow fever is an arbovirus with two transmission cycles: sylvatic and urban. In Brazil, this is considered a notifiable disease, and communication is mandatory and immediate through the Disease Notification and Notification System. **Objective:** To analyze the epidemiological variables and completeness of yellow fever notification forms in the state of Mato Grosso do Sul. **Method:** This is a descriptive study with data from yellow fever notifications from the Disease and Notification Information System of Mato Grosso do Sul, from 2007 to 2022. **Results:** There were 102 notifications of suspected cases, and the years with the highest rates of occurrence of notifications were, respectively: 2008 (n = 30), 2017 (n = 15), 2018 (n = 15), and 2022 (n = 10). Two cases of yellow fever were confirmed, one in 2008 and another in 2010. Most notifications for suspected and confirmed cases were represented by males. Regarding the completeness of the "occupation" data, none of the municipalities reached completion above 90%; in the variable "signs and symptoms", only 13 municipalities reached completion above 90%; and in relation to the "epidemiological antecedents", only four municipalities had more than 90% completion. It should be noted that most of the information regarding suspected and confirmed cases was not filled in. **Conclusions:** The notification system is incomplete and has little information on suspected and confirmed cases of the disease, that is, it does not reflect the real occurrence and magnitude of this public health problem in the state.

KEYWORDS: Arbovirus Infections; Public Health Surveillance; Aedes; Disease Notification; Health Information Systems

RESUMO

Introdução: A febre amarela é uma arbovirose e apresenta dois ciclos de transmissão: silvestre e urbano. No Brasil, é considerada doença de notificação compulsória e a comunicação é obrigatória e imediata, por meio do Sistema de Notificação de Agravos e Notificações. **Objetivo:** Analisar as variáveis epidemiológicas e a completude das fichas de notificação de febre amarela no estado de Mato Grosso do Sul. **Método:** Trata-se de um estudo descritivo com dados da notificação de febre amarela do Sistema de Informação de Agravos e Notificação de Mato Grosso do Sul, no período de 2007 a 2022. **Resultados:** Foram realizadas 102 notificações de casos suspeitos, sendo os anos com maiores índices de ocorrências de notificação respectivamente: 2008 (n = 30), 2017 (n = 15), 2018 (n = 15) e 2022 (n = 10). Foram confirmados dois casos de febre amarela, sendo um em 2008 e outro em 2010. A maior parte das notificações dos casos suspeitos e confirmados foi representada por indivíduos do sexo masculino. Com relação à completude dos dados "ocupação", nenhum município atingiu preenchimento acima de 90%; na variável "sinais e sintomas" apenas 13 municípios atingiram preenchimento acima de 90% e, em relação

aos “antecedentes epidemiológicos”, apenas quatro municípios tiveram mais de 90% de preenchimento. Nota-se que a maioria das informações referentes aos casos suspeitos e confirmados não estavam preenchidas. **Conclusões:** O sistema de notificação de febre amarela é incompleto e possui poucas informações sobre os casos suspeitos e confirmados da doença, ou seja, não reflete a real ocorrência e a magnitude deste problema de saúde pública no estado.

PALAVRAS-CHAVE: Infecções por Arbovírus; Vigilância em Saúde Pública; Aedes; Notificação de Doenças; Sistemas de Informação em Saúde

INTRODUCTION

Yellow fever (YF) is caused by an arbovirus of the *Flaviviridae* family, *Flavivirus* genus, comprising positive single-stranded RNA viruses[1]. It has two transmission cycles: one sylvatic, affecting non-human primates (NHP) with vectors of the genus *Haemagogus* and *Sabethes*, and the other urban, transmitted by *Aedes aegypti* mosquitoes. Patients with YF usually present with fever, headache, myalgia, nausea, and fatigue[2], and can progress to severe forms with manifestations of complications, with high lethality rates[3].

Globalization and intense human mobility have worried the population of many countries due to the possibility of the introduction of the virus responsible for YF[4]. This is due to the low vaccination coverage shown in the adult population[5], and also to insecticide treatments, as many mosquitoes develop resistance, such as *Ae. aegypti*, which is the main transmitter of the YF, Zika, chikungunya, and dengue viruses[6].

It is estimated that 47 countries, 34 in Africa and 13 in Central and South America, are endemic for YF. In addition, in 2018, five countries in the Americas reported confirmed cases of the disease: Bolivia, Brazil, Colombia, French Guiana, and Peru[7].

In Brazil, YF is considered a compulsorily notifiable disease and suspected cases must be reported immediately through the Disease and Notification Information System (SINAN), with various fields to be filled in, allowing epidemiological investigation of suspected cases and outbreaks, interpretation and analysis of data, recommendations for prevention and control measures, and feedback to the information system[3].

In the three-year period from 2017 to 2019, Brazil experienced the largest epidemic of YF since the 1940s. In addition to the Amazon region, cases were reported in Bahia, Minas Gerais, São Paulo, Paraná, and Rio Grande do Sul[8]. With this in mind, this study aims to analyze the epidemiological variables and the completeness of YF notification forms in the state of Mato Grosso do Sul.

METHOD

This is a retrospective, descriptive and cross-sectional study carried out in 2023, obtained from the SINAN database, with notified cases of YF from 2007 to 2022. The data is publicly available on request.

The empirical sample was the state of Mato Grosso do Sul, made up of 79 municipalities, located in the Brazilian Midwest region, with a territorial extension of 357,147,995 km^2 and an estimated population of 2,839,188 people. The state’s main economic activity is agriculture, with the production of soybeans, corn, sugar cane, cotton, and cattle breeding[9].

All the notification forms for suspected and confirmed cases of YF registered by the Municipal Health Departments of Mato Grosso do Sul were included. Duplicate notification forms and those without individual identification were excluded, in accordance with the General Data Protection Law and the Access to Information Law.

The variables analyzed were: date of notification, municipality of notification, date of occurrence, date of first symptoms, final classification (wild or urban YF), laboratory confirmation by serology, viral isolation, hospitalization, evolution of cases, isolation of the virus in mosquitoes, presence of *Ae. aegypti* in the region, and occurrence of monkey mortality. Personal data were also collected: age, race, schooling, previous vaccination for YF, occupation, and living in an urban or rural area.

A suspected case is defined as an individual with an acute febrile condition of up to seven days, of sudden onset, accompanied by jaundice and/or hemorrhagic manifestations, residing in or coming from an area at risk or places where epizootics have occurred in NHP or virus isolation in vectors in the last 15 days, who has not been vaccinated against YF or whose vaccination status is unknown[10].

A confirmed case is defined as a suspected case with at least one of the following conditions: virus isolation, positive M-class immunoglobulin capture enzyme-linked immunosorbent assay (MAC-ELISA), compatible histopathological report with epidemiological link, four-fold or more increase in IgG antibody titers using the hemagglutination inhibition technique, or detection of viral genome; or asymptomatic or oligosymptomatic individual originating from active search who has not been vaccinated and who presents positive serology[10].

The YF notification form has 70 fields to be filled in with specific information and 16 complementary fields. The fields filled in can be assessed for completeness, which refers to the degree to which each variable analyzed is filled in. Completeness was assessed by determining the percentage of records not filled in (ignored or blank) or with invalid values for the selected variables.

The quality of completion was compared between the municipalities in the state that reported suspected and confirmed cases of YF in relation to the variables "occupation", "signs and symptoms", and "epidemiological history". The completeness rates of the selected variables were classified as: poor (when less than 70% of the data is filled in, among all notified cases), regular (when 70 to 89.9% of the data is filled in), and excellent (when the data is filled in in more than 90% of cases)[11].

The database was organized in Microsoft Excel version 10 and then included in the GraphPad Prism program version 7. This study did not require approval from the Human Research Ethics Committee, as it was working with publicized open data, but all the recommendations of Resolution No. 466, of December 12, 2012, of the National Health Council were respected, and it was authorized by the Mato Grosso do Sul State Health Department.

RESULTS

Analysis of notifications of suspected and confirmed cases

The epidemiological surveillance system for YF is in place in all the municipalities in Mato Grosso do Sul, and 102 suspected cases were reported. The years with the highest notification rates were 2008 (n = 30), 2017 (n = 15), 2018 (n = 15), and 2022 (n = 10), with no cases reported in 2011. There were two confirmed cases in 2008 and 2010. There were also seven inconclusive cases, 16 cases not performed, and 14 cases not completed, all related to the criteria for confirming the diagnosis of YF (Figure 1).

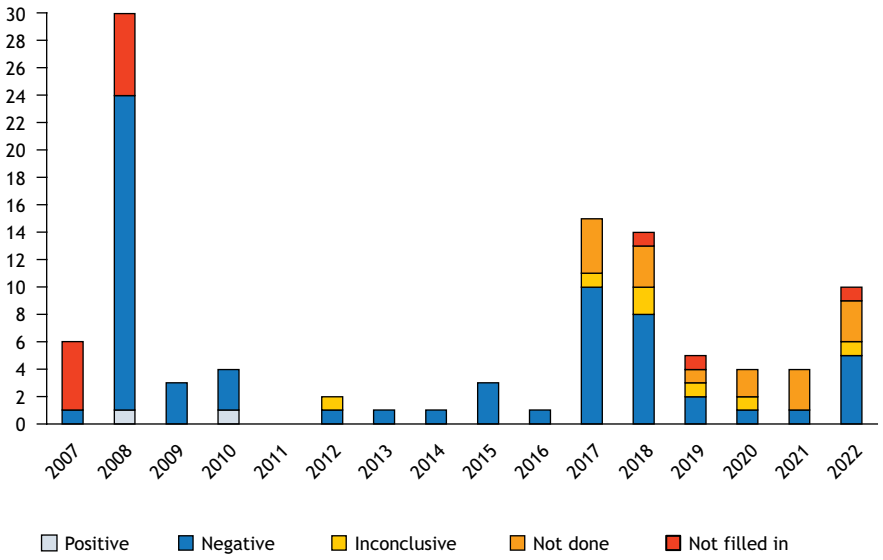
The characterization of notified cases (suspected and confirmed) is shown in Table 1. Most suspected and confirmed cases were reported by males (64%), whites (49.5%), and students (21.0%) and rural workers (14.5%) prevailed in terms of occupation. In terms of age group, the highest prevalence was between 39 and 48 years (23%). The notified cases were presented and classified according to the criterion of confirmation of diagnosis in 67.5% by means of laboratory tests (Table 1).

Regarding the progression of the disease, the following signs and symptoms were most common: abdominal pain (61.0%), hemorrhagic signs (21.5%), Faget sign (14.5%), and renal excretion disorders (22.5%). The YF vaccination status of notified patients shows that this information is generally ignored (45.0%), but 59.0% were vaccinated, among the notifications that contained this information (Table 1).

Most of the suspected and confirmed patients required hospitalization (79.5%), but 10 of the forms lacked this information. Regarding the presence of the *Ae. aegypti* mosquito in urban areas, 44/66 (66.5%) were positive and 22/66 (33.5%) were unknown. However, the virus was not isolated in any mosquito near the homes of the 102 reported cases. About the occurrence of epizootics, six (6%) notifications identified the occurrence of animal deaths, four in 2008, one in 2015 and one in 2022.

Concerning the location of suspected and confirmed cases, there were no notifications in most municipalities (Figure 2).

Regarding the completeness of the "occupation" data (Figure 3A), the municipalities of Corumbá, Porto Murtinho, Nioaque, Chapadão do Sul, and Inocência had the best completeness, however, they did not reach a completeness above 90%. On the other hand, the "signs and symptoms" variable (Figure 3B) was better filled in, with the following municipalities: Corumbá, Ponta Porã, Nioaque, Aquidauana, Sidrolândia, Terenos, Rochedo, Chapadão



Source: Prepared by the authors based on data extracted from SINAN, 2023.
Yellow fever notifications between 2007 and 2022.

Figure 1. Distribution of notified yellow fever cases in Mato Grosso do Sul.

Table 1. Epidemiological profile of suspected and confirmed yellow fever cases, Mato Grosso do Sul, 2007 to 2022.

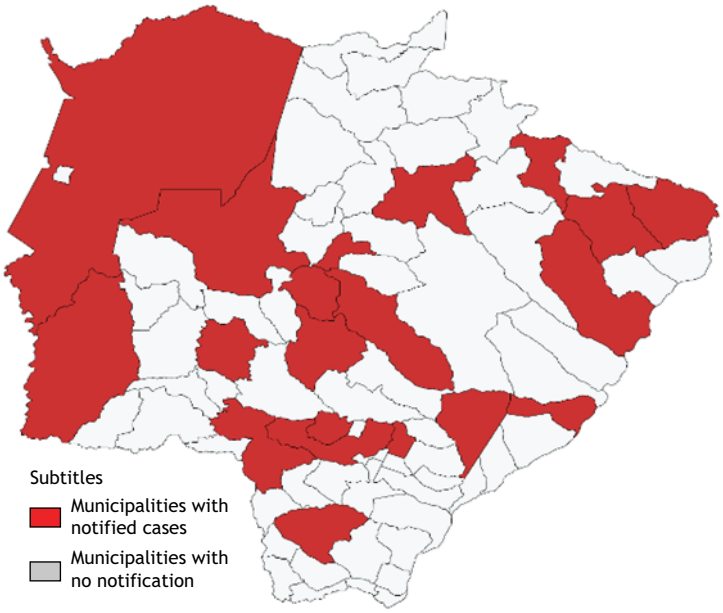
Variables		n	%
Sex *102/102 (100%)	Male	65/102	64.0
	Female	37/102	36.0
Age group *101/102 (99%)	14 to 17 years	6/101	6.0
	18 to 28 years old	17/101	16.5
	29 to 38 years old	16/101	15.5
	39 to 48 years old	23/101	23.0
	49 to 58 years old	13/101	13.0
	59 to 68 years old	13/101	13.0
	Over 69 years old	13/101	13.0
Color/race *91/102 (89%)	White	45/91	49.5
	Brown	35/91	38.5
	Black	6/91	6.5
	Indigenous	5/91	5.5
Schooling *65/102 (64%)	Illiterate	1/65	1.5
	Incomplete 1st to 4th grade	9/65	13.5
	Complete 1s to 4th grade	5/65	7.5
	Incomplete 5th to 8th grade	13/65	20.0
	Complete primary education	8/65	12.5
	Incomplete high school	10/65	15.5
	Complete high school	8/65	12.5
	Incomplete higher education	3/65	4.5
	Complete higher education	8/65	12.5
Diagnosis	Laboratory tests	69/102	67.5
	Epidemiological data	15/102	14.5
Symptomatology	Abdominal pain	62/102	61.0
	Hemorrhagic signs	22/102	21.5
	Faget sign	15/102	14.5
	Renal excretion disorders	23/102	22.5
Vaccination status *56/102 (55%)	Vaccinated	33/56	59.0
	Not vaccinated	23/56	41.0
Occupation *48/102 (47%)	Student	10/48	21.0
	Rural worker	7/48	14.5
	Construction worker	4/48	8.5
	Other	27/48	56.0

Source: Prepared by the authors based on data extracted from SINAN, 2023.
Epidemiological profile of suspected and confirmed cases of compulsory notification of yellow fever in Mato Grosso do Sul between 2007 and 2022.
* number of forms with the information/number of notified forms (percentage of forms with the information filled in).

do Sul, Paranaíba, Inocência, Três Lagoas, Dourados, and Amambaí. About "epidemiological history" (Figure 3C), above 90% are the municipalities of: Sidrolândia, Rochedo, Três Lagoas, and Paranaíba. The state capital, Campo Grande was below 70% complete for all three items.

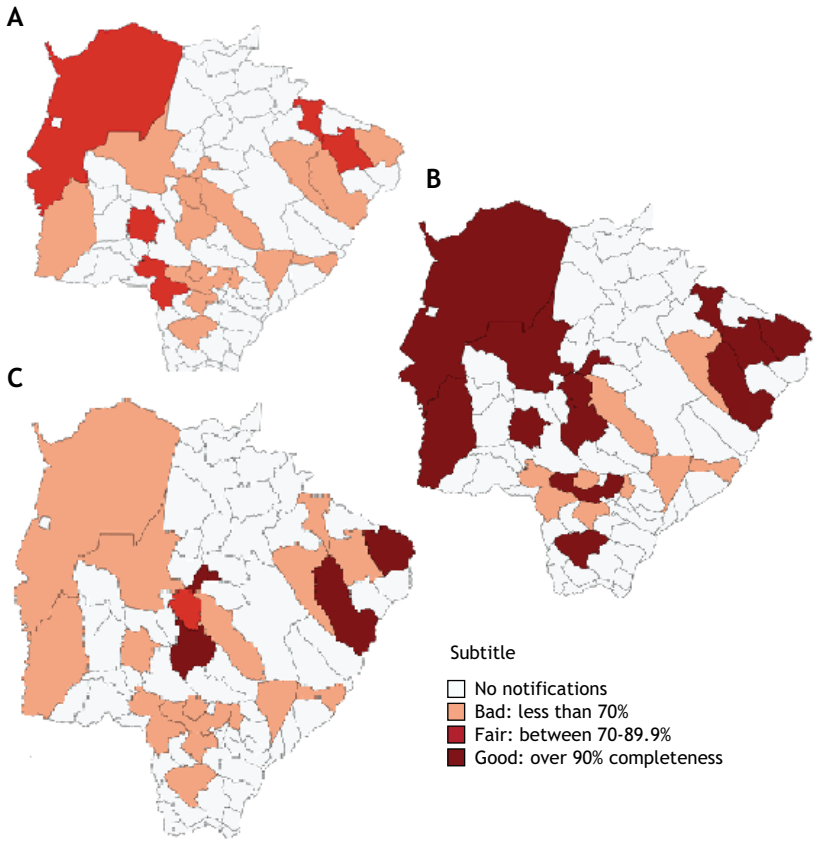
Analysis of confirmed cases

Regarding the analysis of the confirmed cases (n = 2), the investigation data is described below (Table 2). Both cases occurred in men. One case had received the immunization 13 days before



Source: Prepared by the authors based on data extracted from SINAN, 2023.
Municipalities with compulsory notification in SINAN of suspected and/or confirmed cases of yellow fever, Mato Grosso do Sul. Municipalities with no notification.

Figure 2. Municipalities with suspected and/or confirmed cases of yellow fever, Mato Grosso do Sul.



Source: Prepared by the authors based on data extracted from SINAN, 2023.
A) Occupation, B) Signs and symptoms, and C) Epidemiological history of yellow fever compulsory notification forms in SINAN, Mato Grosso do Sul.

Figure 3. Evaluation of the completeness of the "occupation", "signs and symptoms", and "epidemiological history" variables.

Table 2. Confirmed cases of yellow fever in SINAN, Mato Grosso do Sul, 2007 to 2022.

Parameters	Case 1	Case 2
City of notification	Maracaju	Corumbá
Month/Year of occurrence	January/2008	February/2010
Color/race	White	Brown
Education	1st to 4th grade - incomplete PE	Ignored
Sex	Male	Male
Age group	59 to 68 years old	49 to 58 years old
YF vaccine	Yes	No
Month/Year of YF vaccination	January/2008	No
Hospitalization	Yes	Yes
Serology (1st collection)	Reagent	Reagent
Serology (2nd collection)	Not done	Not done
Viral isolation	Yes	No
Viral isolation result	Ignored	Not applicable
Total bilirubin	10.50 mg/dL	Ignored
Direct bilirubin	08.48 mg/dL	Ignored
TGO	2,174 U/L	Ignored
TGP	5,113 U/L	Ignored
Faget sign	No	No
Abdominal pain	Yes	Yes
Hemorrhagic signs	Yes	Yes
Renal excretion disorders	Yes	No
Classification	Silvestre	Silvestre
Place of infection	Undetermined	Autochthonous residence
The outcome of the case	Death	Death

Source: Prepared by the authors based on data extracted from SINAN, 2023.
Laboratory tests and clinical investigation of confirmed cases of yellow fever in SINAN, Mato Grosso do Sul.
YF: Yellow fever; PE: primary education.

showing symptoms of YF and the other case had no record of vaccination.

DISCUSSION

YF is an immunopreventable arbovirus and is considered a disease of tropical regions. The high costs of mass vaccination in a country of continental dimensions and the limited adherence to immunization programs result in low vaccination coverage[12]. It is well known that the state of Mato Grosso do Sul is predominantly devoted to agriculture and livestock farming and also has a wide range of tourist attractions related to rural and wild environments[13]. Humans can therefore come into contact with vectors and reservoirs infected with the YF virus.

In Brazil, transmission occurs seasonally, with peak transmission from December to May. However, in 2018, epizootics (monkey deaths) were identified in other months. The Amazon region is considered endemic, and, in recent decades, cases have been identified in other regions, especially those with low vaccination coverage[7].

From 2016 to 2019, there were the largest outbreaks of the re-emergence of the disease in the country, with 2,237 cases of YF reported and 759 deaths confirmed in states in the Southeast, previously considered to be at low risk of occurrence[14]. The control of YF is articulated with the different areas: surveillance of suspected human cases, immunization, entomology, and epizootics. It is known that, as a zoonosis, YF cannot be eradicated, so the actions taken are aimed at reducing its occurrence and preventing re-urbanization, through early diagnosis and the adoption of control measures[10].

Suspicions of YF begin with reports of exposure to a recent outbreak or to rural and/or wild environments in the previous 15 days, associated with the presence of an acute febrile condition with two or more signs and symptoms such as headache (mainly supraorbital), myalgia, low back pain, malaise, chills, nausea, jaundice, and/or hemorrhagic manifestations. As these symptoms, especially the initial non-specific symptoms, are common to other arboviruses prevalent in the state, particularly dengue, the initial suspicion can be reinforced if there is exposure to the risk of exposure to YF[3].

According to the Brazilian Ministry of Health, the specific diagnostic criteria for YF include serological tests, with the first sample to be taken five days after the onset of symptoms and the second sample between 14 and 21 days after the first sample, or, in a single sample, five days after the onset of symptoms. Diagnosis can also be carried out using viral isolation and reverse transcription polymerase chain reaction (RT-PCR) molecular biology on blood samples up to five days after the onset of symptoms, and on tissue samples no later than 24 hours after death. Histopathology/immunohistochemistry can also be carried out on tissue samples no more than 12 hours after death[3].

Regarding entomology, the presence of the YF virus in *Haemagogus* spp., *Sabethes* spp. and *Ae. aegypti* mosquitoes should often be assessed. Following the outbreak of YF, the state of São Paulo developed an investigation of the main vectors and ecological factors associated with the emergence and circulation of YF in the country, containing individual agents representing mosquitoes, breeding sites, NHPs, and other vertebrate animals that live and interact in an environment that has the YF virus[15]. The state of Mato Grosso is responsible for similar monitoring.

In cases of epizootic diseases, the State Health Departments, together with the Ministry of Health, will only confirm positive cases of YF by means of conclusive laboratory tests or a link with an animal from the same location or an epizootic related to cases of viral circulation in vectors[16]. Whole blood samples are used for viral isolation or detection of the viral genome using the RT-PCR molecular technique, and serum samples for the presence of antibodies for the diagnosis of YF[10].

In this study, the most frequently reported symptom in the notified cases was abdominal pain, followed by renal excretion disorders and hemorrhagic manifestations, the latter of which is considered a criterion for severity. It should be noted that the data obtained are those available on SINAN, which does not describe other associated symptoms, which compromises the overall assessment of cases, particularly mild cases. In the two confirmed cases, the clinical alterations highlighted were also abdominal pain and hemorrhagic manifestations, and only in case one was there a disorder of renal excretion.

There are limitations in terms of laboratory screening and epidemiological data, especially in relation to filling in specific fields, such as important records of the individual's occupation, which were omitted from most of the notifications, preventing cases from being correlated with activities in rural areas. It is believed that transmission/origin is predominantly sylvatic, however, the association between the exposure of suspected and confirmed individuals and ecotourism, leisure and work practices cannot be affirmed, as only one case had a record of occupation and the activity was work-related.

An investigation carried out in Rio de Janeiro, using notification data from 2017 to 2018, showed that of 52 confirmed cases, 86.5% were men, with a median age of 49.5 years, and 40.4% were rural workers. The most frequent signs and symptoms were fever (90.4%), jaundice (86.5%), nausea and/or vomiting (69.2%), changes in renal excretion (53.8%), bleeding (50.0%), and abdominal pain (48.1%), with comorbidity in 38.5% of cases. Lethality was 40.4% and the factors associated with the highest chance of death were: hemorrhage, changes in renal excretion and maximum values of direct bilirubin, aspartate aminotransferase (AST or TGP), alanine aminotransferase (ALT or TGO). Alterations in renal excretion and ALT were significant predictors of a greater chance of death. A borderline effect was also observed for AST. The cut-off points identified as high risk for death were ALT or TGO > 4,000 U/L and AST or TGP > 6,000 U/L[17].

In this study, only one confirmed case contained laboratory records, which occurred in the municipality of Maracaju, and these are close to those compatible with criteria of severity and high risk of death, such as ALT or TGO > 5,000 U/L, AST or TGP > 2,000 U/L, direct bilirubin > 8 mg/dL, and alterations in renal excretion. It should be noted that viral isolation was only carried out in this case and the result was ignored.

It is known that, after transmission, the virus replicates at the site of inoculation and then spreads to the lymph nodes and then to tissues and organs. YF is therefore considered a systemic infectious disease. Severe cases are characterized by liver and kidney failure, coagulopathy and shock. Liver dysfunction and even fulminant liver failure can occur. In addition, liver failure contributes to coagulation disorders[8].

Two cases of YF were confirmed in this investigation, using the serological method. Both patients showed rapid clinical deterioration, with an interval of five and nine days between the onset of symptoms and death, demonstrating the high lethality of severe cases of the disease. A review of YF cases in Brazil from 1990 to 2016 showed a mortality rate of 51.8% and demonstrated that lethality is higher when the number of cases is lower, i.e. it maintains an inversely proportional historical relationship[18]. This can be explained by the efficiency of health surveillance services during outbreaks, with better management of epidemiological events[19].

A study using historical data on YF patients in the United States revealed that cities with higher population densities had higher YF occurrence rates[20]. In addition, vector-borne diseases represent a global burden due to their impact on health systems[21].

Analyses of the completeness of essential data, such as occupation, signs and symptoms, and epidemiological data showed significant flaws in the filling out of notification forms, with a predominance of missing information. A study carried out in Espírito Santo, which evaluated confirmed cases during the 2017 epidemic in relation to clinical, laboratory and epidemiological aspects, noted the need to use complementary spreadsheets to those of SINAN to facilitate the detection of suspected cases, considering the presence of: fever, headache, myalgia in people from risk areas, as well as a failure in the epizootic surveillance system, in which the detection of the first human case was simultaneous with that of NHP[22].

Another study carried out in the same state showed that the results found in SINAN on the spatial distribution of YF showed poor to regular completeness for several of the study variables, pointing to the need for a systematic assessment of the quality of the information generated[23].

Other compulsorily notifiable diseases also reflect the problem of completeness. In an investigation carried out in Campinas/SP concerning the quality of the data from the epidemiological surveillance system for leptospirosis, good levels of completeness were reported, but it mainly had flaws in the integration between the different systems, negatively impacting the implementation of intervention measures[24].

It is well known that to understand the real epidemiological situation of notifiable diseases and provide quality, reliable information, it is necessary to complete the forms with correct, up-to-date data, as well as the epidemiological evaluation and analysis of a disease or condition. Failures in this system jeopardize the adoption of appropriate intervention measures[3].

The emergence and re-emergence of arboviruses is a major public health challenge for the world, due to their high dispersal potential, their vertebrate and invertebrate hosts, their universal susceptibility to infection in undisturbed areas, and the possibility of generating extensive outbreaks with the occurrence of serious cases. They are diseases with no specific treatment and several with no specific vaccines[25].

Unlike most other diseases, YF has a specific, effective vaccine with few related adverse events, which has been produced in Brazil since the middle of the last century[12]. Vaccine hesitancy is related to false information, inadequate knowledge, lack of time to get vaccinated, vaccine insecurity and fear of adverse events[26].

Therefore, monitoring vaccination coverage and the flow of unvaccinated people is essential for controlling YF in rural and wild environments[27]. However, there is no systematic record of the vaccination control of people in wild environments. This investigation highlighted this problem through negligence in filling in the vaccination status of suspected and confirmed cases of YF. It is also worth remembering the human, social and economic impacts related to these diseases, such as: absenteeism, deaths, sequelae, challenges for vaccine production, overload of health services during epidemics.

This study has limitations because it was developed with secondary data and has inconsistencies. By analyzing the percentage of non-completion (blank fields and/or with ignored information) of some common essential or mandatory variables, it was possible to observe flaws in the operational surveillance system. This study is important for mobilizing public entities to continuously train and raise awareness among work teams to qualify epidemiological, virological, vector, and epizootic surveillance actions, allowing the definition of concrete strategies for prevention and health promotion, especially in relation to emerging and re-emerging infectious diseases. In addition, to encourage new studies to fill the knowledge gaps in literature on the subject.

CONCLUSIONS

This study showed that the proportion of positive (confirmed) cases evaluated in the period was low compared to the total number of individuals notified. There was a predominance of white males, whose main symptom was abdominal pain, and the main age group was 39 to 48 years. Most of them had undergone laboratory tests, but vaccination and occupation data were not recorded. It can be seen that the YF notification system is incomplete and has little information on suspected and confirmed cases of the disease, i.e. it does not reflect the real occurrence and magnitude of this public health problem in the state.

Considering the wide spread of the vector in our country, the impossibility of controlling the sylvatic cycle of the disease, the low vaccination coverage, the intense human mobility associated with the growth of activities in rural areas, whether for work or tourism, it is clear that the re-urbanization of YF is a real threat and requires multiple, effective, well-structured, integrated and quality surveillance measures.

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Authors' Contribution

Cañedo MC, Ferro LMT, Massarine NCM, Pires MAS, Almeida PS, Neitzke-Abreu HC - Conception, planning (study design), data acquisition, analysis, interpretation, and writing of the paper. Santos CRL – Data analysis, interpretation, and writing of the paper. All the authors approved the final version of the paper.

Conflicts of Interest

The authors declared no conflicts of interest.