

EVALUATION OF THE LEPTOSPIROSIS SURVEILLANCE SYSTEM, CEARÁ, 2014–2023

AVALIAÇÃO DO SISTEMA DE VIGILÂNCIA DA LEPTOSPIROSE, CEARÁ, 2014-2023

EVALUACIÓN DEL SISTEMA DE VIGILANCIA DE LEPTOSPIROSIS, CEARÁ, 2014-2023

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ABSTRACT

Objetivo: Avaliar o sistema de vigilância da leptospirose, no Ceará, no período de 2014 a 2023. **Métodos:** Estudo do tipo transversal, descritivo, retrospectivo, utilizando a metodologia proposta pelo Centers for Disease Control and Prevention dos Estados Unidos da América (EUA), no qual foram analisados os atributos qualidade dos dados e representatividade. **Resultados:** A completude foi ruim (69,0%); a consistência foi de 94,7%; e o sistema revelou-se representativo, possibilitando descrever o comportamento da doença ao longo do tempo e sua distribuição na população por pessoa e lugar. **Conclusões:** O sistema de vigilância da leptospirose no Ceará teve uma completude ruim, entretanto, mostrou-se consistente e representativo.

Descritores: Leptospirose; Sistema de Informação em Saúde; Vigilância em Saúde Pública.

RESUMO

Objective: To evaluate the leptospirosis surveillance system in the state of Ceará, Brazil, during the period from 2014 to 2023. **Methods:** This was a cross-sectional, descriptive, retrospective study utilizing the methodology proposed by the Centers for Disease Control and Prevention (CDC) of the United States of America (USA), which analyzed the attributes of data quality and representativeness. **Results:** Completeness was poor (69.0%); consistency was 94.7%; and the system was shown to be representative, enabling the description of the disease's behavior over time and its distribution in the population by person and place. **Conclusions:** The leptospirosis surveillance system in Ceará had poor completeness; however, it was consistent and representative.

Descriptors: Weil Disease; Health Information System; Public Health Surveillance.

RESUMEN

Objetivo: Evaluar el sistema de vigilancia de leptospirosis en Ceará, de 2014 a 2023. **Métodos:** Estudio transversal, descriptivo, retrospectivo, utilizando la metodología propuesta por los Centros para el Control y la Prevención de Enfermedades de los Estados Unidos de América (EE.UU.), en el que se analizaron los atributos de calidad y representatividad de los datos. **Resultados:** La completitud fue deficiente (69,0%); La consistencia fue del 94,7%; y el sistema demostró ser representativo, permitiendo describir el comportamiento de la enfermedad en el tiempo y su distribución en la población por persona y lugar. **Conclusión:** El sistema de vigilancia de la leptospirosis en Ceará tenía poca completitud, sin embargo, demostró ser consistente y representativo.

Descriptores: Enfermedad de Weil; Comunicación en Salud. Vigilancia en Salud Pública.

INTRODUÇÃO

Leptospirosis is an acute, multi-systemic, potentially severe infectious disease. Its etiologic agents are bacteria of the genus *Leptospira*, with over 300 serovars identified and grouped into 25 serogroups. The species *Leptospira interrogans* is of the greatest medical interest as it groups all pathogenic leptospira strains¹.

In addition to humans, various animal species are affected by these spirochetes, which are present in the urine of synanthropic rodents (mainly rats), as well as infected domestic animals (dogs, cattle, swine, sheep, horses) and wild animals. When eliminated

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into the environment, they contaminate the soil, water, and food²⁻³.

Clinical manifestations are variable, ranging from asymptomatic and mild forms to severe conditions that present diverse symptoms depending on the disease's evolutionary phase. In the early phase, classic symptoms include sudden onset of high fever, headache, intense muscle pain, especially in the calves, nausea, and vomiting. The late phase, known for severe clinical manifestations such as Weil's syndrome, is characterized by jaundice, renal failure, and multiple hemorrhages in the lungs, central nervous system, skin, and mucous membranes⁴.

Classified as a neglected tropical disease (NTD) by the World Health Organization (WHO), leptospirosis is a public health problem, especially in tropical and subtropical climate regions⁵⁻⁶. In Brazil, leptospirosis is endemic, with cases occurring in every month of the year. Nevertheless, the country is susceptible to epidemic outbreaks during months with high rainfall, primarily in areas of social vulnerability within the urban spaces of capital cities and metropolitan regions that are irregularly and disorderly occupied with high population concentrations. Substandard infrastructure, including poor water security, housing, basic sanitation, and access to health services, facilitates the occurrence of pooling and flooding, as well as the propagation of rodents, thus favoring the occurrence of outbreaks and epidemics⁷.

Leptospirosis cases are registered across the entire Brazilian territory, with the highest incidence in the South (27%) and Southeast (31%) regions⁶⁻⁷. In the period from 2007 to 2023, the annual average number of confirmed cases of the disease was 3,400. Over 80% of those affected were men, aged between 20 and 49 years, urban residents, who had contact with flood water or mud and rodents⁷. It is estimated that 601 cases of leptospirosis were confirmed in the state of Ceará between 2014 and 2023, resulting in an average of 60 cases per year. Among the confirmed records, males, in the age groups considered economically active (between 20 and 49 years old), and residing in peripheral urban areas were the most affected⁸.

As a serious disease of great public health importance, leptospirosis is included in the national list of compulsory notification of diseases, health problems, and public health events. All suspected cases and outbreaks must be reported and registered within 24 hours by health professionals or those responsible for public or private health establishments⁹.

The Ministry of Health considers an individual with fever, headache, and myalgia to be a suspected case of leptospirosis if they present at least one of the following criteria: Criterion 1 - suggestive epidemiological history in the 30 days prior to the date of symptom onset (exposure to risk situations, epidemiological link to a laboratory-confirmed case, or residing/working in risk areas); Criterion 2 - at least one of the following signs or symptoms: conjunctival suffusion, signs of acute renal failure, jaundice and/or increased bilirubin, and hemorrhagic phenomenon⁴.

The relevance of evaluating the leptospirosis surveillance system in Ceará is based on the study's originality, which will allow verification of whether the system is meeting the objectives for which it was created, and also contribute to its improvement, supporting correct decision-making.

Therefore, the objective of this study was to evaluate the leptospirosis surveillance system in the state of Ceará, Brazil, during the period from 2014 to 2023.

MÉTODOS

This was a retrospective, cross-sectional, and descriptive evaluation study with a quantitative and qualitative approach, utilizing secondary data recorded in the Sinan system, which were made available by the Department of Informatics of the Brazilian Unified Health System (DATASUS)¹⁰. The information refers to confirmed leptospirosis cases among residents of Ceará, Brazil, during the period from 2014 to 2023. Ceará is one of the Brazilian states that compose the Northeast region, and its total area is 148,894.447 km², distributed across 184 municipalities. It is the eighth most populous state in Brazil, and its capital, Fortaleza, is the fourth most populous city in the country and the largest in the Northeast region¹¹.

To analyze the attributes of the surveillance system, an adapted methodology from the Centers for Disease Control and Prevention (CDC) of the United States was utilized. The qualitative attributes (data quality: completeness and consistency) and the quantitative attribute (representativeness) were evaluated¹².

One of the indicators of the data quality of a surveillance system is completeness, which can be understood as the proportion of properly filled fields (mandatory and essential) analyzed in a data collection instrument¹³. From the mandatory fields, the following were selected for analysis: age, sex, month of symptom onset, and autochthonous case in the municipality of residence. From the essential fields, the variables race/color, education level, occupation, confirmation or discard criterion, work-related disease, probable area of infection, and environment of infection were selected due to their epidemiological importance.

The completeness of each selected field was evaluated using a calculation that considered the number of notifications with the field properly filled as the numerator, and the total number of notifications evaluated per study year as the denominator. Fields left blank or marked as "ignored" or "not applicable" were considered incomplete. The adopted criteria were: excellent ($\geq 95\%$ completeness), good ($\geq 90\%$ to $< 95\%$), moderate ($\geq 70\%$ to $< 90\%$), poor ($\geq 50\%$ to $< 70\%$), and very poor ($< 50\%$)¹⁴.

Consistency refers to the coherence in data entry when variables are related to one another¹² and was evaluated by quantifying inconsistent responses in the selected variable fields relative to the total number of records. To identify system inconsistencies, the following variables were selected: notification date $\leq$ date of symptom onset, notification closure date $\leq$ notification date, and final classification with an empty (blank) confirmation or discard criterion. The evaluation scores were standardized as excellent ($\leq 10\%$ inconsistency), moderate ($> 10\%$ and $\leq 30\%$), and poor ($> 30\%$)¹⁴.

Representativeness is defined as the system's capacity to accurately describe the occurrence and magnitude of health events across time, person, and place¹². This attribute was evaluated by comparing the profile of confirmed leptospirosis cases in the DATASUS database with leptospirosis epidemiological bulletins published by the Ceará State Health Secretariat (SESA) and scientific literature focused on describing the disease, emphasizing the variables: age group, sex, race/color, education level, probable area of infection, environment of infection, and month of symptom onset. The incidence coefficient per study year was also evaluated.

The data were analyzed using absolute frequency, relative frequency, central

tendency, and the goodness-of-fit test for equal expected proportions, employing the Epi Info™ 7.2.6.0 software, the Microsoft Excel 2016® program, and Tabwin® 3.6.

This study utilized an epidemiological database containing public domain and free-access information via DATASUS, which maintains the anonymity of individuals. Therefore, in accordance with Resolution No. 510 of the National Health Council, dated April 7, 2016, submission of this methodology to an Institutional Review Board (IRB) is not required¹⁵.

RESULTADOS

The mandatory fields, such as age, sex, and month of symptom onset, exhibited excellent completeness (100.0%), while “autochthonous case in the municipality of residence” obtained a very poor completion percentage (0.0%) throughout the study period. The results of the essential field assessment showed that the variables “probable area of infection” (55.7%), “occupation” (58.0%), and “work-related disease” (59.2%) were classified as poor. “Environment of infection” (44.2%) and “education level” (48.0%) had very poor completeness. The fields “race/color” (94.8%) and “confirmation or discard criterion” (98.3%) showed the highest completion percentages (Table 1).

Consequently, the database demonstrated an average completeness percentage of 69.0%, which classifies the data quality of leptospirosis notifications in the state of Ceará as poor.

Regarding the observed inconsistencies, 25 records (4.2%) were found where the notification date was less than or equal to the date of first symptoms, and 10 notifications (1.7%) had a final classification with a confirmation or discard criterion left blank. The evaluation for these variables was classified as excellent because the result was less than 10% inconsistency. For the variable closure date less than or equal to the notification date, 61 records (10.2%) were identified, which was evaluated as moderate ($>10\%$ and $\leq 30\%$). Despite the discrepancies found, the database showed an overall excellent classification, recording 5.3% inconsistencies (Table 2).

Table 1. Evaluation of the completeness of mandatory and essential variables in the leptospirosis surveillance system. Ceará, 2014–2023 (N=601).

VARIABLES	Completeness (%)											Evaluation
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Mean Completeness	
Mandatory												
Age	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Excellent
Sex	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Excellent
Month of 1st symptoms	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Excellent
Autochthonous case in the municipality of residence	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Very Poor
Essential												
Race/Color	94.0	100.0	97.9	89.2	96.2	96.4	97.7	95.5	90.3	91.1	94.8	Good
Education Level	52.0	43.3	37.5	50.0	42.3	40.5	50.0	51.1	52.4	61.1	48.0	Very Poor
Occupation	54.0	46.7	43.8	64.3	63.5	59.5	54.5	66.7	58.3	68.9	58.0	Poor
Confirmation or discard criterion	98.0	100.0	100.0	96.4	92.3	98.2	100.0	100.0	99.0	98.9	98.3	Excellent
Work-related disease	74.0	50.0	56.3	60.7	55.8	52.3	54.5	64.4	62.1	62.2	59.2	Poor
Probable area of infection	54.0	50.0	56.3	67.8	55.8	51.4	50.0	57.8	60.2	53.3	55.7	Poor
Environment of infection	44.0	33.3	35.4	57.1	48.1	42.3	36.4	53.3	46.6	45.6	44.2	Very Poor

Source: Ministry of Health - Notifiable Diseases Information System (Sinan); data collected in August 2024.

Table 2. Evaluation of the data consistency of the leptospirosis surveillance system. Ceará, 2014–2023 (N=601).

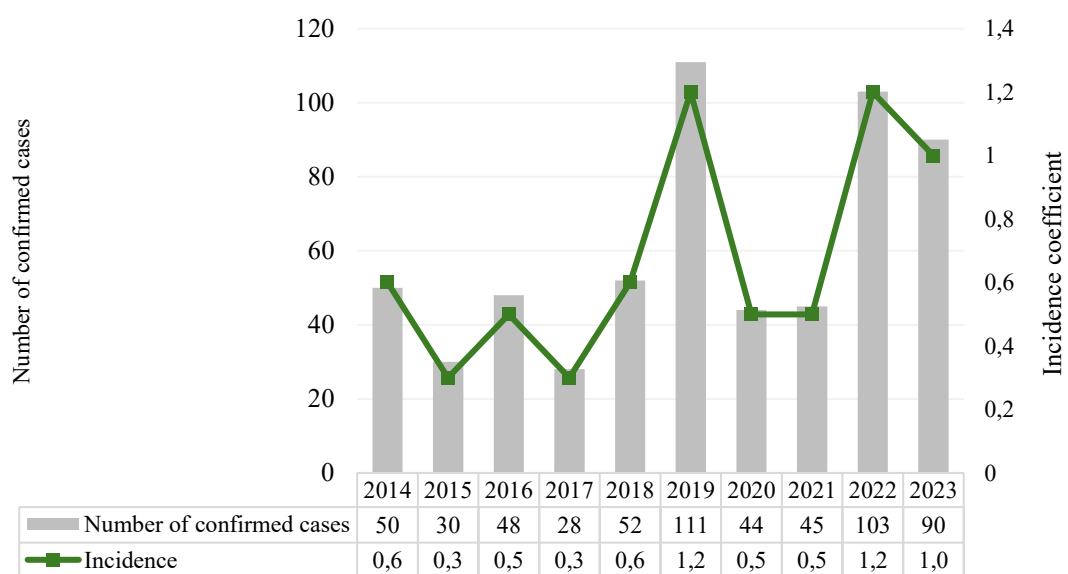
VARIABLES	INCONSISTENT RECORDS	% INCONSISTENCY	EVALUATION
Notification date less than or equal to the date of first symptoms	25	4.2	Excellent
Closure date less than or equal to the notification date	61	10.2	Moderate
Final classification with confirmation or discard criterion left blank	10	1.7	Excellent

Source: Ministry of Health - Notifiable Diseases Information System (Sinan); data collected in November 2024.

The leptospirosis surveillance system was considered geographically representative because it was implemented in all municipalities in the state, despite the inability to guarantee its capacity to detect leptospirosis cases in all 184 Ceará municipalities.

Considering the analysis period between 2014 and 2023, the number of confirmed leptospirosis cases and the incidence coefficients (per 100,000 inhabitants) per year are represented in Figure 1.

Figure 1. Distribution of the number and incidence coefficients of confirmed leptospirosis cases (per 100,000 inhabitants). Ceará, 2014–2023 (N=601).



Source: Ministry of Health - Notifiable Diseases Information System (Sinan); data collected in August 2024.

The results revealed that 601 cases were confirmed in Ceará during the period, with an annual average of 60 records. The occurrence of the disease varied throughout the analyzed interval. The incidence coefficient ranged from 0.3 to 0.6 cases per 100 thousand inhabitants between 2014 and 2018, demonstrating a cyclic pattern of behavior. The years with the highest incidences were 2019 and 2022 (1.2 cases per 100 thousand inhabitants), and the lowest were 2015 and 2017 (0.3 cases per 100 thousand inhabitants). A significant reduction in the incidence coefficient (0.5 cases per 100 thousand inhabitants) was observed in the 2020-2021 biennium when compared to the years 2019 and 2022.

Regarding sociodemographic characteristics, a greater predominance of cases was observed in males (79.9%), in the 20 to 39 age group (41.8%), of brown race/color (85.0%; *parda*), and with completed high school (11.3%). As for the probable area of infection, the largest number of records was found in the urban area (38.1%), with the household (29.3%) as the environment of infection (Table 3).

Table 3. Distribution of confirmed leptospirosis cases according to sociodemographic characteristics. Ceará, 2014–2023 (N=601).

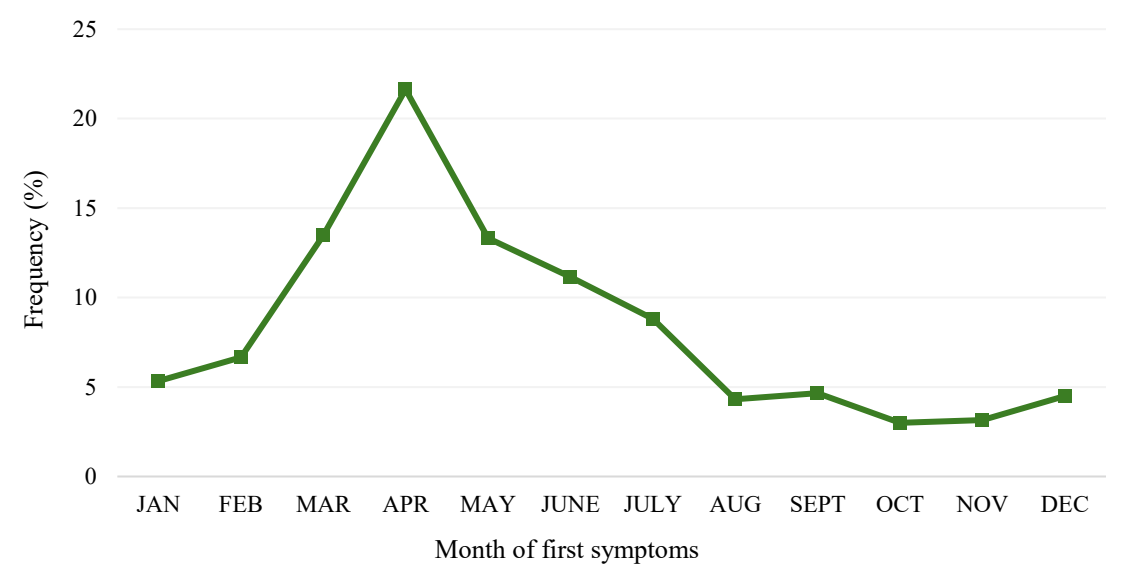
Sex	n	%
Male	480	79.9
Female	121	20.1
Age group (Years)	n	%
< 1 year	2	0.3
1-4	2	0.3
5-9	11	1.8
10-14	15	2.5
15-19	46	7.7
20-39	251	41.8
40-59	187	31.1
60-64	32	5.3
65-69	21	3.5
70-79	27	4.5
80 and +	7	1.2
Race/color	n	%
Brown (<i>Parda</i>)	511	85.0
White	41	6.8
Ignored/Blank	34	5.7
Black	14	2.3
Yellow	1	0.2
Education Level	n	%
Illiterate	25	4.2
1st to 4th grade incomplete – ES	35	5.8
4th grade completed – ES	18	3.0
5th to 8th grade incomplete – ES	53	8.8
Completed Elementary School	36	6.0
Incomplete High School	26	4.3
Completed High School	68	11.3
Incomplete Higher Education	6	1.0
Completed Higher Education	15	2.5
Ignored/Blank	309	51.4
Not applicable	10	1.7
Probable Area of Infection	n	%
Ignored/Blank	269	44.8
Urban	229	38.1
Rural	97	16.1

Peri-urban	6	1.0
Environment of Infection	n	%
Ignored/Blank	335	55.7
Household	176	29.3
Work	55	9.1
Other	22	3.7
Leisure	13	2.2

Source: Ministry of Health - Notifiable Diseases Information System (Sinan); data collected in August 2024.

The frequency of disease cases according to the month of first symptoms indicated that April (21.6%) was the month with the highest number of records, followed by March (13.5%) and May (13.3%) (Figure 2).

Figure 2. Frequency of confirmed leptospirosis cases according to the month of first symptoms. Ceará, 2014–2023 (N=601).



Source: Ministry of Health - Notifiable Diseases Information System (Sinan); data collected in August 2024.

DISCUSSÃO

The completeness of the data in the leptospirosis surveillance system in Ceará was considered poor based on the criteria used. This result diverges from the study by Lara *et al.*¹⁶, which evaluated the epidemiological surveillance system for leptospirosis in Campinas, São Paulo, and showed a database with excellent completeness. According to these authors, the essential variables – occupation (23.2%), education level (82.6%), environment of infection (83.5%), and probable area of infection (84.4%) – were also the least filled, results that corroborate those recorded in the present study.

For Diz and Conceição⁶, the failure to complete mandatory and non-mandatory but essential fields compromises epidemiological investigation actions, as well as the implementation of prevention and control strategies. Information regarding occupation and work-related disease is relevant to the disease profile, as several authors in the literature cite that the illness may be related to occupational activities. Similarly,

information on the level of education is important for evaluating the profile of the population at risk.

In the assessment of the leptospirosis surveillance system attributes, data consistency was classified as excellent, given that the inconsistencies found occurred in less than 10% of the records, which is in agreement with the information found by Lara *et al.*¹⁶.

Based on the analysis of leptospirosis case incidence coefficients in Ceará during the 2014–2023 period, the information recorded in Sinan showed a scenario similar to that published in state epidemiological bulletins, with a cyclic incidence pattern in the years 2014 to 2018, peaks in 2019 and 2022, and a significant drop in 2020 and 2021¹⁷⁻¹⁸.

According to the Ceará Foundation for Meteorology and Water Resources (FUNCEME)¹⁹, the period of intense rain (rainy season) runs from February to May. In 2019, the rainy season was the third best recorded in the state in the last decade, with 676.3 millimeters of precipitation. In 2022, the accumulated volume of rain was the eighth best result in the last 20 years, totaling 621.3 millimeters, exceeding the historical average for the period, which is 600.7 millimeters. This registered volume of rain may have favored the high incidence of the disease in the mentioned years.

The expressive decline in incidence coefficients in 2020 and 2021 can be attributed to the COVID-19 pandemic. Social distancing and isolation measures, which decreased the circulation of people and consequently their exposure to risk environments, along with the possible underreporting of cases due to reduced seeking of health facilities out of fear of contamination, may explain the observed drop. Conversely, changes in the population's habits and sanitation measures adopted during the pandemic may also have contributed to the reduction in leptospirosis transmission.

The profile of confirmed case notifications in the state of Ceará revealed characteristics similar to other studies analyzed. The disease predominantly affected males, aged between 20 and 59 years. This panorama suggests that the male population in the economically active age group is more susceptible to risk factors due to engaging in unhealthy occupational activities in informal jobs that facilitate infection. This information confirms the data from state epidemiological bulletins and the study developed by Albuquerque *et al.*²⁰ in Pernambuco. The highest concentration of cases was among individuals of brown race/color (*parda*), a finding also evidenced by Albuquerque *et al.*²⁰, Ribeiro and Vieira Neto²¹ in the state of Goiás, and Ramos²² in Bahia.

Regarding education level, the highest frequency of confirmation occurred in individuals with completed high school, a scenario different from that described by Albuquerque *et al.*²⁰ and Ramos²², who found a higher percentage of records in people with incomplete elementary school. Low education level can lead to lower income and, consequently, precarious housing and sanitation conditions, favoring the occurrence of cases. Concerning the environment of infection, Albuquerque *et al.*²⁰ identified the household as the environment with the highest predominance of records, a finding similar to that of this study.

The seasonal behavior of leptospirosis notifications is directly associated with high rainfall. In the state of Ceará, intense rains occur from February to May. Thus, the analysis of case distribution by month of symptom onset showed that the months of March, April, and May concentrated the highest number of new cases, which diverged from the data identified in the works from Pernambuco²⁰ and Bahia²².

Based on data analysis, the evaluation of the selected variables was considered representative, as it was possible to describe the distribution of leptospirosis cases across time, person, and place.

The present study had limitations related to data incompleteness and inconsistency. These limitations directly impact the quality of the information produced. Data quality in a surveillance system refers to the completeness, consistency, accuracy, and relevance of the collected information necessary for the monitoring and response to public health events¹⁶. The failure to complete essential fields, as well as data inconsistency, generates a misleading view of the real health situation of people, impeding adequate epidemiological analysis of the occurrence of diseases/health problems, outbreaks, and epidemics, risk factors, probable sources of infection, susceptible population groups, and vulnerable areas. This results in harm to the development of effective strategic actions for the prevention and control of the disease and public policies for population health protection.

In the consulted literature, information regarding the probable area of infection was not found. Finally, as observed in the study by Aguiar *et al.*²³, it is noteworthy that publications on the evaluation of the leptospirosis surveillance system are scarce, despite the disease being a public health problem in the country.

CONCLUSÃO

It is concluded that the evaluation of the data quality of leptospirosis notifications in the state of Ceará, for the period analyzed, showed a significant percentage of incompleteness in variables important for the objective analysis of the disease's epidemiological scenario and the planning of public policies aimed at improving population health. The information and data generated in the Sinan system were consistent and representative for the selected variables, as they described the behavior of leptospirosis over time and its distribution in the population by person and place.

Given the leptospirosis scenario in the state of Ceará, the following are recommended: The training of health professionals to utilize the notification instruments completely, consistently, and timely; Continuous awareness-raising among managers and health professionals for the complete filling of the investigation form, especially the essential fields, as they record data indispensable for case investigation and the calculation of epidemiological and operational indicators; Systematic database cleaning and periodic evaluation of the surveillance system to improve the quality of recorded data; Analysis of the operational system to change the classification of essential fields to mandatory; Promotion and/or incentive for health education actions among the population to disseminate information that contributes to the knowledge of the disease.

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