ORIGINAL ARTICLE

EVOLUTION OF AMERICAN TEGUMENTARY LEISHMANIASIS CASES REPORTED IN PARANÁ STATE, BRAZIL

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SUMMARY

Leishmaniases are infectious diseases caused by protozoa of the genus *Leishmania*. They are widely distributed worldwide and endemic in 88 countries in four continents. The present study analyzed the reported cases of American Tegumentary Leishmaniasis (ATL) in Paraná State (Brazil) from January 2007 to December 2013. The data were grouped according to Regional Health (RH) districts and macroregions, which allowed visualization of the reality in each region in the state. A total of 2,879 ATL cases were reported and distributed among the 22 RH districts, with an average detection rate of 3.9 cases per 100,000 inhabitants. The northwestern region accounted for 50.1% of the total cases, and the northern region accounted for 26.0-76.1% of the reported cases. The 6th RH district did not report any cases. The 7th, 9th, and 18th RH districts had a higher cure rate (> 80%), and lower cure rates were found in the 1st, 4th, and 12th RH districts. Reported unfavorable outcomes included treatment abandonment and death. Overall cure rates are based on the entire country, and unfavorable outcomes require greater attention of managers and health professionals to meet the goals of the Brazilian Ministry of Health.

KEYWORDS: *Leishmania* sp.; Cutaneous leishmaniasis; Notifiable diseases; Epidemiology; Epidemiological monitoring.

INTRODUCTION

Leishmaniases are infectious diseases caused by protozoa of the genus *Leishmania* that affect the skin, mucous membranes, and viscera. Different forms of the disease are widely distributed worldwide and is endemic in 88 countries in four continents, affecting approximately 2 million people annually1,2. Human clinical forms include cutaneous leishmaniasis (CL) and visceral leishmaniasis (VL), which have a prevalence of 1 million cases and 500,000 cases per year, respectively. Cutaneous leishmaniasis is characterized by single or multiple lesions or ulcers on the skin and mucous membranes. Mucosal lesions mainly involve the oral and nasopharyngeal regions and can be persistent, disfiguring, and difficult to cure clinically1,3. However, American Tegumentary Leishmaniasis (ATL) detection, the selection of therapeutic strategies, and monitoring by qualified health professionals are essential for resolving the disease3.

Initially, ATL was considered a wild disease that affected humans accidentally. Infection was related to labor activities in the forestry, mining, and construction industries1,4. In Paraná State, vast areas with modified residual forests provide evidence for the endemicity of disease5. In recent years, epidemiological studies have shown that individuals can become vulnerable to infection in their peridomicile, where vectors of *Leishmania* have been captured6,7,8,9.

In southern Brazil, 94.6% of ATL cases were reported in Paraná State from 1990 to 2013. Both genders are affected by CL, with a higher incidence in males, which may be associated with leisure activities that are more often practiced by men, such as fishing. The most affected age group is between 21 and 50 years old. Case detection has mainly been performed in Northern and Western Paraná8,9. Paraná State has a total of 399 municipalities. ATL cases were distributed among 276 cities until 2002, and since 2008, ATL has been reported in more than 300 cities10.

Among the challenges faced by Brazil in solving health problems are its large geographical area and major socioeconomic differences. Over the years, the Ministry of Health has formulated new public health policies and developed specific strategies, such as regionalization. According to the Brazilian Federal resolution n°. 399/GM (published in February the 22th, 2006), the National Council of Health Secretaries (Conselho Nacional de Secretários de Saúde - CONASS) regionalization provided a guideline for the National Health System and a structural axis for the Management Pact. The purpose of the regionalization was to guide and decentralize governmental actions and health services, aid the negotiation
process, and foster agreements amongst regional managers. This policy also ensured the accessibility, resolution, and quality of health actions and services, which depend on the complexity and number of inhabitants, and transcends the local/municipal level. The Intermunicipal Consortium of Public Health; Paraná, Brazil (Consortório Público Intermunicipal de Saúde do Setentrão Paranaense - CISMUSEP) is a new model of partnership between municipalities of Paraná State and the Federal government, where all are focused on the improvement of health care for the local population. The CISMUSEP offers consultation services which perform specialized tests and procedures in 30 cities from the 15th Regional Health of National Health System.

The Paraná State has a land area of 199,307.922 km²; 10,444.526 inhabitants, and 399 municipalities. In 2015, there were 22 Regional Health (RH) districts in Paraná. The RHs are characterized by regional and geographical clippings or limits that seek to organize the network of health activities and services to ensure compliance with the constitutional principles of universal access, equity, and comprehensive care.

In Brazil, the Information System for Reportable Diseases (Sistema de Informação de Agravos de Notificação - SINAN) was developed in the 1990s to standardize the recording, consolidation, and sharing of data on reportable diseases, such as ATL. The efficient use of these data seeks to achieve dynamic diagnoses of the occurrence of an event, indicating the risk for particular populations, and determining the epidemiological reality of specific geographic areas. In addition to collecting routine data, the interpretation of results and information is complex and requires skilled personnel. Many problems have arisen, including low coverage, over collected data, insufficient analysis, low quality, delay in analysis, and a lack of communication of the information obtained, which can all lead to the loss of appropriate intervention opportunities. Additionally, the information is often restricted to the study site, which does not allow broader interpretations. Data on the evolution of reported cases of ATL in Brazil are recorded in the information area of the public health system, referred to as Health Unic System (Sistema Único de Saúde - SUS). Considering the high prevalence of ATL in Paraná State and Brazil’s regionalization policy, the dearth of publications on the evolution of cases is concerning. Thus, we analyzed the evolution of reported ATL cases in Paraná State between 2007 and 2013 and discussed the issue considering the regional context of each RH district.

MATERIALS AND METHODS

The present study was descriptive and cross-sectional. Data were obtained from the DATASUS database of the Department of Informatics of SUS (Brazil) from January 2007 to December 2013. This database receives information from SINAN, which records and processes data on ATL notifications and provides information as a morbidity profile analysis, thus contributing to decision-making at the municipal, state, and federal levels.

The search was performed using the following variables: RH district, municipality of residence, events taking place in the case, year of occurrence, patients who met the cure criteria, patients who abandoned treatment, patients who continued treatment in another RH district, cases in which the diagnosis of ATL changed, the occurrence of death attributable to ATL, the occurrence of death attributable to other causes (i.e., the cause of death was not related to ATL), and unknown outcomes. The statistical analysis included all the cases of ATL in Paraná per year according to RH district and macroregion. The RH districts were distributed according to the regions of the state: North (RH districts: 16th, 17th, 18th, 19th, and 22nd), Northwest (RH districts: 11th, 12th, 13th, 14th, and 15th), West (RH districts: 8th, 9th, 10th, and 20th), South Central (RH districts: 5th and 7th), Campos Gerais (RH districts: 3rd, 4th, 6th, and 21st), and East (RH districts: 1st and 2nd). The ATL detection coefficient was calculated using the population that was estimated in 2010 by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística - IBGE). Pearson correlations and Student’s t-test were applied to analyze the disease progression according to time (in years). The statistical analyses were performed using the Stata 9.1 software (Stata Corp LP, Texas, USA) by considering a confidence interval of 95%.

The present study was performed according to the Helsinki Declaration of 1964, lastly revised in 2012, and also in accordance with Resolution n° 466/2012 of The Brazilian National Health Council (Conselho Nacional de Saúde - CNS) and approved by the Standing Committee on Ethics in Human Research of Universidade Estadual de Maringá, Maringá City, Paraná State, Brazil.

RESULTS

Between January 2007 and December 2013, 2,879 cases of ATL were reported in Paraná State, distributed among 22 RH districts. Considering that Paraná had a population of 10,444,526 inhabitants in 2010, the cumulative detection rate over seven years (2007-2013) was 27.6 cases per 100,000 inhabitants. In 2007, the number of reported cases was 459 (4.4 cases per 100,000 inhabitants). In 2008, a peak of the disease occurred, with 566 (21.9%) of the cases (5.4 per 100,000 inhabitants). The number of ATL cases (Fig. 1) was 461 in 2009 (4.4 per 100,000 inhabitants), 277 in 2010 (2.7 per 100,000 inhabitants), 351 in 2011 (3.4 per 100,000 inhabitants), 469 in 2012 (4.5 per 100,000 inhabitants), and 296 in 2013 (2.8 per 100,000 inhabitants). In Paraná State in the period of 2007 to 2013, the average ATL detection rate was 3.9 cases per 100,000 inhabitants.

Of the 2,879 ATL cases, the majority (2,031 or 70.5%) were cured. A total of 643 patients (22.3%) had unknown outcomes, and the RH districts that had a high number of unknown outcomes were the 12th, 13th, 14th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, and 22nd. The cumulative frequency based on the number of ATL cases reported in Paraná State between 2007 and 2013 and discussed the issue considering the regional context of each RH district.

![Fig. 1 - Cumulative frequency based on the number of ATL cases reported in Paraná State, Brazil, 2007-2013.](image-url)
district (51%), 22nd district (34.1%), 16th district (27%), and 20th district (26.7%). The other outcomes included the abandonment of treatment, continued treatment in another RH district, changes in diagnosis, and death due to ATL or other causes (Table 1).

Most of the cases were reported in the Northwestern and Northern regions (Table 2). The Northwestern region accounted for 50.1% of cases. The 13th and 15th RH districts had the highest frequency of reported leishmaniasis (18.0% and 14.5%, respectively). No notification was found in the 6th RH district during the period studied (Table 1, Fig. 2). The highest cure rate (80%) occurred in the 7th, 9th, and 18th RH districts (Table 1). The Northern and Northwestern regions achieved 67.8% and 73.0% cure rates, respectively (Table 2, Fig. 3). The 2nd RH district had a good cure rate compared with the other districts. The lowest cure rates were found in the 1st (28.5%), 4th (33.3%), and 12th (46.3%) RH districts (Table 1).

The Northern and Northwestern regions had a higher number of reported ATL cases, and also of cases with unknown outcomes compared with other regions ($p < 0.05$; Fig. 3). Although these regions had a significant number of cases with unknown outcomes, a higher cure rate was observed in these regions (North: 28.0%; Northwest: 48.9%), whereas Campos Gerais had a lower cure rate (0.5%, $p < 0.05$). The Northwest had the highest number of deaths that occurred by other causes, not specified by the SINAN database. The comparison between the evolution and outcome of ATL cases of Northern and Northwestern regions were not different; both played a significant role in the distribution and evolution of ATL in Paraná State.

**DISCUSSION**

The transmission standard of ATL varies according to specific regions in Brazil, with higher frequencies in the North (46.1%) and Northeast (29.4%). The comparison between the evolution and outcome of ATL cases of Northern and Northwestern regions were not different; both played a significant role in the distribution and evolution of ATL in Paraná State.

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**Table 1**

Evolution of reported ATL cases obtained by SINAN according to Regional Health districts in Paraná State, 2007-2013

<table>
<thead>
<tr>
<th>RH/PR</th>
<th>Cure</th>
<th>Abandonment</th>
<th>Transfer</th>
<th>Diagnostic Change</th>
<th>Death / ATL</th>
<th>Death / other causes</th>
<th>Ignored / blank</th>
<th>Total notif./RH</th>
</tr>
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<tr>
<td></td>
<td>N %</td>
<td>N %</td>
<td>N %</td>
<td>N %</td>
<td>N %</td>
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<td>N %</td>
<td>N %</td>
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<tr>
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<td>0 0</td>
<td>2 28.57</td>
<td>2 28.57</td>
<td>0 0</td>
<td>0 0</td>
<td>1 14.29</td>
<td>7 0.24</td>
</tr>
<tr>
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<td>3 1.01</td>
<td>14 4.70</td>
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<td>0 0</td>
<td>2 0.67</td>
<td>71 23.83</td>
<td>298 10.35</td>
</tr>
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<td>0 0</td>
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<td>0 0</td>
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<td>1 14.29</td>
<td>7 0.24</td>
</tr>
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<td>0 0</td>
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<td>0 0</td>
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<td>6 0.21</td>
</tr>
<tr>
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<tr>
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<td>1 9.09</td>
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<td>0 0</td>
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<tr>
<td>8th</td>
<td>20 57.14</td>
<td>0 0</td>
<td>1 2.86</td>
<td>7 20.00</td>
<td>1 2.86</td>
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<td>5 14.29</td>
<td>35 1.22</td>
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<tr>
<td>9th</td>
<td>67 83.75</td>
<td>1 1.25</td>
<td>2 2.50</td>
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<td>0 0</td>
<td>8 10.00</td>
<td>80 2.78</td>
</tr>
<tr>
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<td>3 3.00</td>
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<td>2 0.79</td>
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<td>1 0.19</td>
<td>1 0.19</td>
<td>4 0.77</td>
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<td>518* 17.99</td>
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<tr>
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<td>3 4.92</td>
<td>0 0</td>
<td>2 3.28</td>
<td>8 13.11</td>
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<tr>
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<td>17 4.09</td>
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<td>1 0.24</td>
<td>3 0.72</td>
<td>9 2.16</td>
<td>87 20.91</td>
<td>416* 14.45</td>
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<tr>
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<td>4 2.78</td>
<td>4 2.78</td>
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<td>0 0</td>
<td>2 1.39</td>
<td>39 27.08</td>
<td>144 5.00</td>
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<tr>
<td>17th</td>
<td>189 78.42</td>
<td>12 4.98</td>
<td>3 1.24</td>
<td>2 0.83</td>
<td>0 0</td>
<td>5 2.07</td>
<td>30 12.45</td>
<td>241 8.37</td>
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<tr>
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<td>5 2.31</td>
<td>1 0.46</td>
<td>5 2.31</td>
<td>23 10.65</td>
<td>216 7.50</td>
</tr>
<tr>
<td>19th</td>
<td>81 77.14</td>
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<td>1 0.95</td>
<td>0 0</td>
<td>0 0</td>
<td>2 1.90</td>
<td>21 20.00</td>
<td>105 3.65</td>
</tr>
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<td>20th</td>
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<td>5 4.95</td>
<td>0 0</td>
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<td>2 1.98</td>
<td>27 26.73</td>
<td>101 3.51</td>
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<tr>
<td>21st</td>
<td>5 62.50</td>
<td>0 0</td>
<td>1 12.50</td>
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<tr>
<td>22nd</td>
<td>25 60.98</td>
<td>0 0</td>
<td>0 0</td>
<td>2 4.88</td>
<td>0 0</td>
<td>0 0</td>
<td>14 34.15</td>
<td>41 1.42</td>
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</table>

Total 2031 70.5 57 2.0 38 1.3 53 1.8 12 0.4 45 1.6 643 22.3 2879 100.0
The findings of the present study revealed an average rate of 3.9 cases per 100,000 inhabitants, with data obtained from 276 municipalities. This result demonstrates the geographic expansion of ATL in this state and highlights the importance of regional studies that support the proper allocation of resources, and development of appropriate strategies that are geared toward local realities.

We observed a heterogeneous distribution among RH districts. The number of reported cases was greater in the Northern and Northwestern regions, but both of these regions also presented the highest cure rates and the greatest number of cases with unknown outcomes. Campos Gerais had the lowest cure rate. The Northwestern region had the highest death rate of causes that were unrelated to ATL. These different outcomes reveal that the profile of this endemic disease does not have a definitive and homogeneous distribution pattern, which complicates the adoption of measures by the Brazilian Ministry of Health.

The literature reports that the mentioned regions are the most important areas for the progression and maintenance of ATL. Several studies have discussed many variables that are involved in this process, such as the increasing number of infections in women and children, vector adaptation in domestic environments, the proven presence of L. (V.) braziliensis strains in Paraná State, and the maintenance of ATL focus sites. Identification of sand flies is one of the determining factors for the occurrence of ACL, and in this sense, entomological studies in Paraná State have shown the presence of the following species: Nyssomyia whitmani, Nyssomyia neivai, Pintomysia pessoai, Migonemyia migonei and Pintomyia fischeri. The most prevalent is Nyssomyia whitmani, but all of them have the capacity to transmit Leishmania.

The complexity that characterizes prevention and control measures requires more effort and joint efforts among district/municipal managers, health professionals, and research institutions to optimize resources, which may prevent the advance of leishmaniasis in all regions of Paraná State.

Regarding the evolution of reported cases by RH districts, the majority of cases had achieved a cure, especially in the 7th, 9th, and 11th rural health districts. The cure rate per 100,000 inhabitants was highest in the Southern region (38.1%). The death rate was lowest in the Northern region (1.3%). The cure rate for the Western region was 3.9%, and the death rate was highest in the Northwestern region (7.2%). The cure rate for the Southern region was 38.1%, and the death rate was lowest in the Northern region (1.3%). The cure rate for the Western region was 3.9%, and the death rate was highest in the Northwestern region (7.2%).
The healing of ulcerative lesions and total regression of infiltrators and erythema up to three months after completing the therapy are considered as the criteria for ATL cure\(^1,2\). The Northern and Northwestern regions had a cure rate of 69.6%, which is consistent with the cure rate that is observed nationwide\(^1,10\). In Brazil, in 2009, 90.9% of 23,399 confirmed ATL cases received first-line treatment with meglumine antimoniate, 73.5% of which were cured. However, 16 patients died because of ATL, 122 died because of other causes, and 4,961 cases (21.2%) had no information on the progression of the disease\(^16\). The criteria for the choice of treatment should consider the current state of the patient’s health, lesion characteristics, if the patient is pregnant and comply with the standardization that has been recommended by the World Health Organization\(^1,2\). Although the number of cases that were cured after ATL treatment is recorded in the SINAN information system, the total number of patients who received treatment for ATL was not recorded. These results may be explained by a failure of data collection or the non-inclusion of these data in the information system. It is important to know the number of patients who have access to recommended ATL treatment.

The 2\(^{nd}\) RH district is located in southern Paraná State and corresponds to the metropolitan region of Curitiba (the state capital). The 2\(^{nd}\) RH district comprises 29 municipalities and is one of the ATL focus sites, such as the area of Alto Ribeira\(^29\). The ATL cure rate in the 2\(^{nd}\) RH district standout compared with the other RH districts. The State of Paraná Central Laboratory (Laboratório Central do Paraná - LACEN) located in the 2\(^{nd}\) RH district has the infrastructure to provide early diagnosis and a better prognosis and also does have technologies that, combined with health services, have high quality standards\(^30\).

In the present study, evolution with an unknown outcome was observed in 23.6% of ATL cases. Other studies also found a high incidence of unknown outcomes regarding the evolution of leishmaniasis\(^15,22\). In 1991, the index of unknown outcomes was 49.3%. After two decades, the optimization of actions, and the population attending health services\(^22\), it is clear that these actions are still far from those required by the Brazilian Ministry of Health, which recommends the patient follow-up after medical discharge\(^1\).

The reporting of ATL follows the standards of SINAN, requiring confirmation based on laboratory diagnosis, and clinical/epidemiological criteria that may also be adopted mainly in endemic areas where people are persistently positive for ATL based on laboratory diagnosis\(^1\). Some cases could not be confirmed during the evolution of ATL because of changes in the first diagnosis (1.6% of cases), and the subsequent diagnosis was not documented in SINAN. We believe that these subsequent diagnoses should be identified to clarify this point.

The unfavorable outcomes that were found in the present study included abandonment (2.1%) and death from ATL (0.4%). The Brazilian Ministry of Health considers treatment abandonment as ATL patients who have not been discharged or patients who do not attend the medical consultation within 30 days after the third scheduled visit to evaluate clinical cure, according to the recommended regimen. In the
present study, ATL was not the main cause of death, but the side effects of leishmaniasis therapy and other diseases may be associated with death. Therefore, the cause of death in most cases could be iatrogenic and related to other morbidities.\textsuperscript{31,32}

The other outcomes of the notifications were death from other causes (1.4\%) and the patient’s transfer (1.3\%), and referral to other units for treatment and monitoring. For patients who died during treatment, reasons that are not associated with ATL or not associated with the side effects of the drugs that are used for ATL treatment must be declared and certified that they were not associated with ATL.\textsuperscript{31,32}

The evolution of ATL of the reported cases in Paraná revealed a cyclical tendency for its occurrence. The cure rate achieved by patients after the ATL treatment followed the same tendency as the cure rate that is observed in other regions of Brazil. Still worrisome is the percentage of unknown outcomes and consequently the actual health conditions of patients who received the diagnosis of ATL.

The literature databases have a dearth of studies that explain the causes of ATL treatment abandonment. Studies on treatment abandonment are required, especially because ATL treatment is freely offered by the public health system (SUS) in Brazil, and leishmaniasis is a disease with a good prognosis when treated properly.\textsuperscript{15} The high rate of abandonment of the leishmaniasis therapy encourages the search for alternative therapies for leishmaniasis because of drug toxicity and deaths that are caused by the current treatments. The treatment of ATL needs to be improved. Some studies have been conducted to discover new candidates for leishmaniasis treatment, but few of these products have reached patients, and most initiatives remain in the experimental phase.\textsuperscript{22,23,33,34,35} Additionally, the pharmaceutical industry has been unenthusiastic regarding leishmaniasis, and the therapeutic arsenal is still limited, so that people who live in endemic areas become dependent on traditional medicine to relieve their symptoms.\textsuperscript{33,36,37}

Social and environmental factors still need to be investigated to elucidate the pattern of transmission of leishmaniasis from the perspective of all health care spheres (national, state, and municipal). If the transmissibility profile can be defined, then measures can be adopted to control and cure ATL according to specific localities, and these results may be gradually optimized to further improve healthcare.

The present study explored secondary research data. Considering the heterogeneity of the number of notifications in each RH district, the possibility of underreporting ATL should not be forgotten, and the actual health conditions of local populations should be ascertained. The heterogeneity of the prevalence of ATL among regions, underreporting, and the high number of patients with unknown ATL outcomes make it difficult to plan, execute, and refine public health measures and policies. The collection and interpretation of health data should be routinely performed by qualified health professionals, specialized in information systems. Moreover, information should be disclosed to provide a better understanding of health problems, the results of public health programs, and also the health service coverage. Health professionals should also be trained on the collection, use, and interpretation of data that are obtained by health services and other institutions to identify actual health problems associated with particular local populations. Thus, health organizations should implement specific measures to control and treat ATL more effectively.

REFERENCES


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