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## Estimating and mapping the incidence of giardiasis in Colombia, 2009–2013<sup>☆</sup>



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### SUMMARY

**Background:** Giardiasis is one of the most common intestinal infections in the world. There have been no national studies on the morbidity of giardiasis in Colombia. In this study, incidence rates of giardiasis were estimated for the years 2009–2013.

**Methods:** An observational, retrospective study of the giardiasis incidence in Colombia, 2009–2013, was performed using data extracted from the personal health records system (Registro Individual de Prestación de Servicios, RIPS). Official population estimates from the National Department of Statistics (DANE) were used for the estimation of crude and adjusted incidence rates (cases/100 000 population). **Results:** During the period studied, 15 851 cases were reported (median 3233/year; 5-year cumulated crude national rate of 33.97 cases/100 000 population). Of these, 50.3% were female; 58.4% were <10 years old and 14.8% were 10–19 years old. By region, 17.7% were from Bogotá (10.07 cases/100 000 population, 2009), 10.9% from Antioquia (9.42, 2009), 8.6% from Atlántico (15.67, 2009), and 6.5% from Risaralda (33.38, 2009). Cases were reported in all departments (even insular areas).

**Conclusions:** As giardiasis is neglected in many countries, surveillance is not regularly undertaken. Despite its limitations, this study is the first attempt to provide estimates of national giardiasis incidence with consistent findings regarding affected age groups and geographical distribution.

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## 1. Introduction

Infections due to *Giardia lamblia* (synonymous with *Giardia intestinalis* and *Giardia duodenalis*), or giardiasis, are probably among the most common gastrointestinal conditions caused by protozoa, particularly in children, throughout the world, and especially in developing countries. This flagellated organism has been associated with acute manifestations such as diarrhoea, abdominal cramps, weight loss, nausea, and vomiting.<sup>1</sup> In most

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cases, usually in healthy individuals, symptoms generally subside within <4 weeks. Nevertheless, giardiasis sometimes has long-term consequences, including chronic diarrhoea with or without intestinal malabsorption, recurrent abdominal pain, and weight loss.<sup>1–3</sup>

The epidemiology of giardiasis is well known in many countries, including the associated social and climatic factors.<sup>4,5</sup> Data from surveys, excluding documented outbreaks, indicate that in industrialized countries, the prevalence rate ranges between 2% and 5%.<sup>1</sup> In contrast, the rate varies from 20% to 30% in developing countries.<sup>1</sup> However, a limited number of population-based studies have been performed in these countries, particularly in Latin America.

In Latin America, recent studies from Venezuela (2008) have found giardiasis prevalence ranging from 7.41% to 7.69%.<sup>6,7</sup> In Cuba, the last national survey carried out in 2009 estimated an overall prevalence of *Giardia* infection of 6.02%.<sup>8</sup> However, in Colombia, no study has been conducted at the national level on the morbidity of giardiasis, except for a very limited number of studies published so far from this country regarding the disease in humans.<sup>9,10</sup>

The most recently published study in Colombia (2014), reported a point-prevalence of 11.17% (95% confidence interval (CI) 7.78–14.58%) in children (1–5 years old) from day care centres in Ibagué, Tolima.<sup>11</sup> In a previous study in Bogotá (2006), giardiasis point-prevalence was found to be 6.3% (95% CI 3.95–8.72) in children 5–12 years old.<sup>12</sup>

As part of an effort to enhance the control and risk assessment of giardiasis, the Regional Information System, the Universidad Tecnológica de Pereira (through the Research Group of Public Health and Infection), and the Ministry of Health are working together on the academic analysis of epidemiological information on infectious diseases at the regional and national level,<sup>13–15</sup> including giardiasis. The aim of this study was to estimate the incidence of giardiasis in Colombia between 2009 and 2013 and to develop geographical information system (GIS)-based epidemiological maps for this protozoan disease in the country.

## 2. Methods

Colombia is a South American country made up of 32 departments (main administrative level) (Figure 1). The Colombian territory presents climatic, geographic, and epidemiological conditions suitable for the transmission of *Giardia* and other intestinal protozoa. As in other tropical countries, Colombia comprises large areas where environmental factors such as

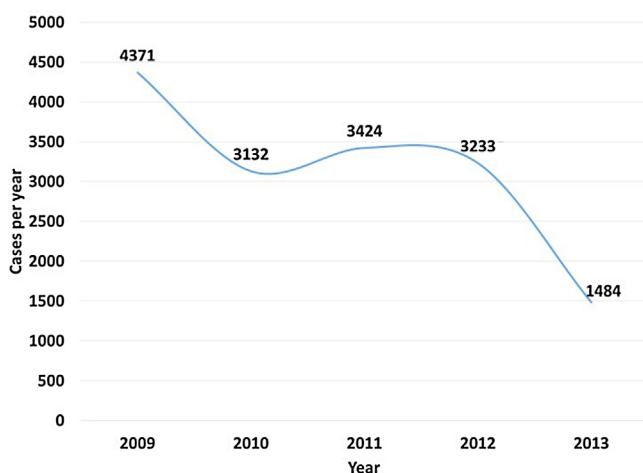


Figure 1. Number of giardiasis cases in Colombia, 2009–2013.

temperature, humidity, precipitation, and altitude, as well as socio-economic factors, are suitable for transmission. This disease is not under surveillance and there is no effective prevention and control program.

For this observational, retrospective study, the epidemiological data were collected from the so-called personal health records system (Registro Individual de Prestación de Servicios, RIPS). The International Classification of Diseases 10<sup>th</sup> revision (ICD-10) code A07.1 was used, given the fact that giardiasis is not included in the surveillance system, to obtain the number of cases from each department of the country by year (2009–2013). Data were obtained with the agreement of the Ministry of Health through the Protection Information System (SISPRO) via a client access server, which allowed cases to be retrieved from the SISPRO server on a local computer. SISPRO RIPS data used for this study came from confirmed cases; the data have been revised in terms of data quality and were obtained initially from data from the National Institute of Health, Colombia and later from SISPRO and its data cubes system. Data for this study came from 33 reference notification units, one per department, and were later consolidated and centralized in Bogotá in the SISPRO system. Currently revised and consolidated data are available for the period 2009–2013. The quality of the RIPS data in Colombia has been described elsewhere.<sup>16,17</sup>

There are no official national guidelines for the management of giardiasis in Colombia or focused diagnosis and treatment documents. The diagnosis of giardiasis is based mainly on copro-parasitological direct evaluation in health system laboratories, where most cases are detected by passive surveillance of stool samples. *Giardia* cysts and/or trophozoites must be seen on microscopy of at least one faecal specimen or duodenal aspirate from the patient.

Using official reference population data (National Administrative Department of Statistics, DANE), estimates of annual incidence rates for all departments of the country during the study period were calculated (32 departments and the capital district, for 5 years; cases/100 000 population) to provide the first estimates of giardiasis incidence in the country by department. Incidence rates were estimated by age group.

In addition, national maps showing the distribution of giardiasis by department by year were generated. Microsoft Access was used to import incidence rates by department and year, to the GIS software. The open source client GIS software used was Kosmo Desktop 3.0 RC1. Access to the required geographic data and result-sharing with institutional support was provided by the spatial data infrastructure for the country, the Instituto Geográfico Agustín Codazzi (National Geographic Institute Agustín Codazzi, IGAC). The shapefiles of departments (.shp) were linked to data table databases through spatial join operation in order to produce digital maps of annual incidence rates by department.

## 3. Results

During the study period, a total of 15 851 cases were reported in Colombia, with a median of 3233 cases per year (ranging from 1484 to 4371 per year) (Figure 1). The number of cases decreased during the study period from 4371 in 2009 (9.72 cases/100 000 population-year) to 1484 in 2013 (3.15 cases/100 000 population-year) (Figure 1). The cumulated crude national rate was estimated to be 33.97 cases/100 000 population × 5 year (Table 1).

Of the total cases, 17.7% were from Bogotá, the capital of the country (10.07 cases/100 000 population in 2009), 10.9% were from Antioquia (9.42 in 2009), 8.6% were from Atlántico (15.67 in 2009), and 6.5% were from Risaralda (33.38 in 2009) (Table 1). Nevertheless, Risaralda, Guanía, Guaviare, Magdalena, and Huila presented the highest cumulated incidence rates for the period

**Table 1**  
Number of cases and estimated incidence rates for giardiasis in Colombia, 2009–2013 by territory

Department	2009		2010		2011		2012		2013		Total period	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases <sup>a</sup>	Rate <sup>b</sup>
Risaralda	307	33.38	215	23.24	205	22.03	179	19.13	115	12.22	1119	109.73
Guainía	19	50.39	13	33.92	6	15.40	0	0.00	0	0.00	138	97.56
Guaviare	7	6.88	35	33.88	9	8.58	16	15.04	1	0.93	132	64.86
Magdalena	210	17.64	144	11.99	119	9.81	165	13.48	77	6.23	768	58.96
Huila	119	11.13	110	10.16	151	13.76	178	16.01	82	7.28	691	58.31
Atlántico	358	15.67	243	10.50	300	12.80	336	14.16	110	4.58	1400	57.47
Meta	125	14.65	68	7.81	93	10.46	79	8.71	33	3.57	440	44.78
Bolívar	192	9.80	116	5.86	215	10.74	221	10.91	109	5.32	890	42.59
Cesar	105	11.01	57	5.90	100	10.21	103	10.39	34	3.39	437	40.76
Bogotá, D.C.	731	10.07	682	9.26	634	8.49	477	6.30	252	3.28	2810	37.18
Santander	247	12.35	127	6.32	125	6.19	139	6.84	100	4.90	770	36.52
Norte de Santander	151	11.74	68	5.24	119	9.09	97	7.34	41	3.08	509	36.35
Tolima	109	7.88	89	6.41	141	10.13	134	9.60	28	2.00	535	36.00
Quindío	30	5.49	49	8.92	53	9.59	48	8.64	7	1.25	220	33.83
Cundinamarca	338	13.87	196	7.91	164	6.52	81	3.17	44	1.69	854	32.69
Antioquia	564	9.42	365	6.02	332	5.40	282	4.53	158	2.51	1726	27.69
Córdoba	119	7.63	101	6.38	79	4.91	102	6.25	42	2.53	468	27.55
La Guajira	46	5.82	50	6.11	36	4.25	63	7.20	34	3.77	252	27.05
Caquetá	23	5.20	11	2.46	42	9.26	32	6.96	13	2.79	145	26.67
Casanare	35	10.95	9	2.76	23	6.93	13	3.85	5	1.45	110	25.62
Sucre	51	6.35	26	3.21	45	5.50	58	7.02	25	2.99	227	25.04
Cauca	51	3.90	65	4.93	108	8.12	79	5.88	29	2.14	355	24.94
Boyacá	93	7.35	65	5.13	44	3.47	47	3.70	28	2.20	297	21.82
Nariño	110	6.79	74	4.51	57	3.43	89	5.29	16	0.94	366	20.84
Caldas	42	4.30	40	4.09	47	4.79	36	3.67	33	3.35	215	20.20
Arauca	3	1.23	7	2.83	17	6.78	18	7.10	1	0.39	64	18.36
Valle del Cauca	172	3.97	92	2.10	132	2.98	148	3.31	57	1.26	613	13.57
Putumayo	11	3.41	11	3.37	14	4.25	6	1.80	2	0.59	57	13.34
Vaupés	1	2.43	0	0.00	0	0.00	3	7.08	1	2.34	15	11.92
Amazonas	1	1.41	0	0.00	3	4.12	1	1.36	2	2.68	14	9.61
Vichada	0	0.00	2	0.61	5	1.51	3	0.89	2	0.58	15	4.28
San Andrés	0	0.00	1	1.36	0	0.00	0	0.00	1	1.33	3	2.70
Chocó	1	0.21	1	0.21	6	1.25	0	0.00	2	0.41	12	2.08
Colombia	4371	9.72	3132	6.88	3424	7.44	3233	6.94	1484	3.15	15 851	33.97

<sup>a</sup> Cumulated number of cases during the period 2009–2013.

<sup>b</sup> Cumulated incidence rate (cases/100 000 population).

studied (>50 cases/100 000 population) (Table 1). In Risaralda, the department with the highest cumulative incidence rate (109.73 cases/100 000 population), 56.6% of the cases came from the capital municipality Pereira (51.82% from its rural areas) and 26.31% came from Dosquebradas (a satellite, neighbour city; 37.06% from its rural areas).

Cases were reported in all of the departments of the country (even in insular areas, such as the San Andrés islands) (Table 1). Of the total number of cases in the study period, 50.3% were female, for an adjusted rate of 33.72 cases/100 000 population (95% CI 33.0–34.0) (Table 2), while 49.7% were male, for an adjusted rate of 34.20 cases/100 000 population (95% CI 34.0–35.0) (Table 2) (no

significant difference,  $p \geq 0.05$ ). The highest incidence rate was found in the <10 years age group, with 107.87 cases/100 000 population (95% CI 106.0–110.0); this was significantly higher than in any other age group (Table 2), representing 58.4% of cases.

#### 4. Discussion

This is the first study to comprehensively describe the epidemiology of *Giardia* infection in Colombia. The incidence of giardiasis in this South American country showed a great decline from 2009 (9.72 cases/100 000 population) to 2013 (3.15 cases/100 000 population). This decline could be related to the improvement in sanitary conditions and general socioeconomic circumstances in the country. The human development index changed from 0.706 in 2010 to 0.718 in 2013, poverty was reduced from 40.3% in 2009 to 30.6% in 2013 (poverty headcount ratio at national poverty lines), and extreme poverty was reduced from 9.3% to 6.1% (poverty headcount ratio at \$1.90 a day). The incidence rate does not seem to be related to sex (49.7% of cases in males and 50.3% of cases in females), but there is a clear significant association with age, with 58% of cases detected in children aged 0–9 years and a descending incidence rate with increasing age. This prevalence among children aged 0–9 years is probably related to poor health hygiene, poor toilet training, overcrowding, low socioeconomic status, close contact with other potentially infected children in child-care settings, and a lack of previous exposure to *Giardia*, which could render them more susceptible to infection and illness.<sup>18,19</sup>

A distinct geographical distribution was found, with eight departments having the highest numbers of cases and incidence

**Table 2**  
Number of cases and estimated incidence rates for giardiasis in Colombia, 2009–2013, by sex and age group; cumulated over 5 years

	Cases	%	Rate (cases/100 000 population)	95% CI
Sex				
Male	7774	49.7	34.20	34.0–35.0
Female	7862	50.3	33.72	33.0–34.0
Age group, years				
<10	9123	58.4	107.87	106.0–110.0
10–19	2399	14.8	26.78	26.0–28.0
20–29	1366	8.7	17.74	17.0–19.0
30–39	1046	6.7	16.79	16.0–18.0
40–49	803	5.1	14.21	13.0–15.0
50–59	499	3.2	11.93	11.9–12.0
60–69	270	1.7	10.79	10.7–11.0
70–79	151	1.0	10.40	10.0–10.9
≥80	58	0.4	9.64	9.0–10.0

95% CI, 95% confidence interval.

rates during the study period (Antioquia, Atlántico, Boyacá, Risaralda, Guainía, Guaviare, Magdalena, and Huila). Bogotá, the capital of the country, reported the highest absolute number of cases (2810), but a cumulative incidence rate of 37.18 cases/100 000 population (Table 1). The situation in Risaralda is concerning, because this department had a total of 1119 cases in the study period, with a cumulative incidence rate of 109.73 cases/100 000 population (Table 1, Figure 2). This may be associated with the contamination of water supplies by sewage in rural areas of the department, even in the capital municipality, which includes rural areas. In addition, social factors, including education, could also be involved, and this requires further study. Furthermore, the present researchers have noted considerable incidence rates for other foodborne diseases in this region, such as leptospirosis.<sup>14</sup>

Further studies should be performed to identify risk factors explaining why these departments (and their municipalities) present the highest morbidity. Interestingly, these findings regarding geographic distribution are consistent with those of previous studies, which reported a high prevalence of giardiasis in Antioquia in 2006 (27.6%) and identified *G. lamblia* as the most frequent intestinal parasite in a cross-sectional study in that year.<sup>20</sup> For the other departments, no previous studies on giardiasis were found for comparison.

In an international context, there are similarities in the behaviour of the disease in Colombia and in the USA. According to the Centers for Disease Control and Prevention (CDC), incidence rates of 6.4 cases/100 000 population and 5.8 cases/100 000 population were recorded in 2011 and 2012, respectively, in the USA, both lower than the rates found in the present study. However, the data could not be compared for 2013, which showed a dramatic reduction in incidence. The relationships with age and sex were also similar, except for a peak incidence reported by the CDC in the 40–49 years age group.<sup>21</sup>

Reports from Europe are too diverse to be used for comparison. The incidence rates in countries from that region vary from 1% to as high as 8% and 11% in countries such as Turkey and Albania.<sup>22</sup> In other European countries, incidence rates (reported as cases per 100 000 population) of 0.93 (France, 2010), 4.47 (Germany 2007), 24.95 (Israel 2009), 63.14 (Russia, 2009), 1.91 (Spain 2001), 16.56 (Sweden 2008), and 6.01 (UK, 2009) have been estimated according to data from the Atlas on Water and Health of the Institute for Hygiene and Public Health at the University of Bonn, the World Health Organization (WHO) Collaborating Centre for Health Promoting Water Management and Risk Communication, and WHO. These data serve as a point of comparison with the present national data and indicate the highly variable behaviour of giardiasis infection. The higher incidence in some of the European

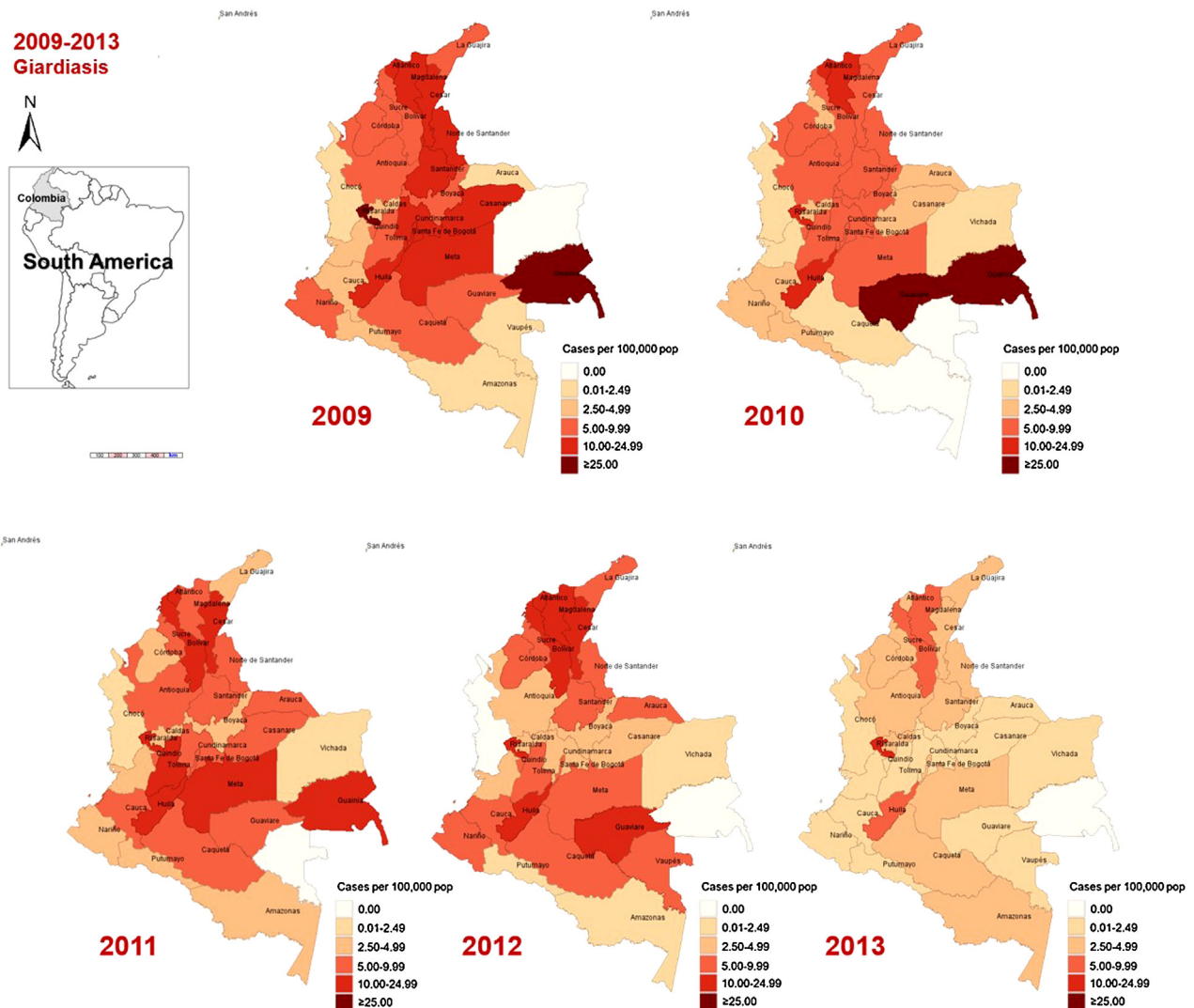


Figure 2. Geographic distribution by GIS-based map of the estimated incidence rates of giardiasis in Colombia by territory, 2009–2013. These maps were made with the use of a geographic information system (Kosmo GIS).



countries is surprising due to their more sophisticated health infrastructure and socioeconomic status, and raises questions for future epidemiological insight. Further Colombian studies are warranted regarding the influence of socioeconomic status on *Giardia* infection. Serbia reported an incidence of 3.55% in 2007 and also, interestingly, an incidence peak in adults aged 20–59 years.<sup>19</sup> In Germany in 2007, there were a total of 3651 cases linked to international travel, and in a case–control study, 83% of the cases occurred in patients aged 20 years or older.<sup>23</sup> Sweden has also reported higher incidence and risk among returning travellers, immigrants, and international adoptees.<sup>24</sup> Although the incidence rates for Colombia are similar to those of some of these countries, the epidemiological characteristics appear to be very different, mainly in terms of the groups affected and the mechanisms of infection, with international travel seeming to be more important in countries like Germany.

Other countries such as Canada and Australia focus their surveillance on giardiasis as a traveller's disease, with studies reporting a diagnosis rate of 2.9% in Canada.<sup>25</sup> Australia reports over 700 cases each year, with an incidence of 1.6% to 7.6%.<sup>26,27</sup> In Australia, a bimodal gender distribution is also seen, with the most affected age groups being 0–5, 6–12, and 25–49 years.<sup>28</sup> These countries show similarities with the present incidence findings, but the same difference arises in the age groups affected.

Although there are multiple studies reporting the prevalence of giardiasis in different populations in Latin America, none are on incidence, limiting comparison with the present study. However, small sample studies from Venezuela have reported prevalence from 19.9% to 32.4%.<sup>29</sup>

Although the results obtained from these analyses provide information on the giardiasis situation in Colombia, they must be interpreted with caution due to possible deficiencies in the Colombian health epidemiology and reporting systems, which may have caused under-reporting of the disease and underestimations of its incidence. In addition, there could be differences between departments, causing additional uncertainty in reporting and producing estimates. It is possible that in departments far from the large cities, under-reporting will be higher. Diagnostic accuracy in giardiasis could also lead to under-reporting of the disease. Nevertheless, the current report shows considerably high morbidity due to *Giardia* infection in Colombia, a result not published previously in a nationwide population-based study.

Despite the limitations of this study, this is the first attempt to provide estimates of national giardiasis incidence in Colombia, and in fact for any Latin American country, with consistent findings regarding the age groups affected and geographical distribution. This study also provides interesting information with implications for travel medicine advice, as travellers are also at risk of giardiasis.<sup>30</sup> More studies are expected and are required for this protozoan disease.

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