Epidemiology of Clinical Sporotrichosis in the Americas

Subjects: Infectious Diseases

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Sporotrichosis is a fungal infection caused by species of the *Sporothrix* genus. In the found 124 publications with reports related to sporotrichosis in the Americas, 12,636 patients got infection caused by species of the genus *Sporothrix*. It was observed that 87.45% (11,050) were reported in South America, 11.55% (1460) in North America, and 1.00% (126) in Central America and the Caribbean.

sporotrichosis | Sporothrix schenckii sensu stricto | the Americas

1. Introduction

Sporotrichosis is a fungal infection caused by thermo-dimorphic fungi species of the *Sporothrix* genus. Previously, the classification of the species of sporotrichosis was conducted through the classification of the *Sporothrix schenckii* complex, which included *Sporothrix schenckii* sensu stricto, *Sporothrix brasiliensis* (*S. brasiliensis*), *Sporothrix globosa* (*S. globosa*), *Sporothrix luriei* (*S. lurieri*), *Sporothrix pallida* (*S. pallida*), *Sporothrix mexicana* (*S. mexicana),* and *Sporothrix chilensis* (*S. chilensis*) [1][2]. However, since 2016, the taxonomical classification of *Sporothrix* has been changed into a clinical clade that includes *Sporothrix schenckii*, *S. globosa*, *S. brasiliensis, and S. luriei*. On some occasions, the species of the environmental clade, such as *S. pallida*, *S. mexicana,* and *S. chilensis* may cause infection upon contact with an individual [1][2][3][4]. The infections occur mainly cutaneously or subcutaneously with lymphatic involvement [1][2][3][4]. This infection has been considered the most frequent subcutaneous mycosis in Latin America [2]. Such infections can be difficult to diagnose with the naked eye since they can be similar to infiltrative or ulcerative lesions from vascular and inflammatory disorders [1][3].

For this subcutaneous infection to develop, a direct trauma must occur first. For example, inoculation occurs when the skin is punctured by plants with thorns, gardeners are a classic case of this. Also, inoculation can occur through fomites that contact contaminated soil. For instance, people who wear sandals can suffer trauma from stones, firewood, or thorns with fungal spores on their surface [2][3]. With all the above, it can be inferred that this type of fungal infection is associated with regions where the main livelihood is agriculture, that is, in environments where the climate is tropical and subtropical. Another form of transmission, which has been increasing in recent times in some regions of the continent such as Brazil, Argentina, Paraguay, and Panama, has been reported to result from scratches, bites, pecks, and stings from different animals [1][2][3][4].

There are several techniques for detecting sporotrichosis, including Sabouraud dextrose agar cultures, lactophenol blue or erythromycin staining, histopathological studies, and PCR sequencing, among others [5][6][7] (**Figure 1**).

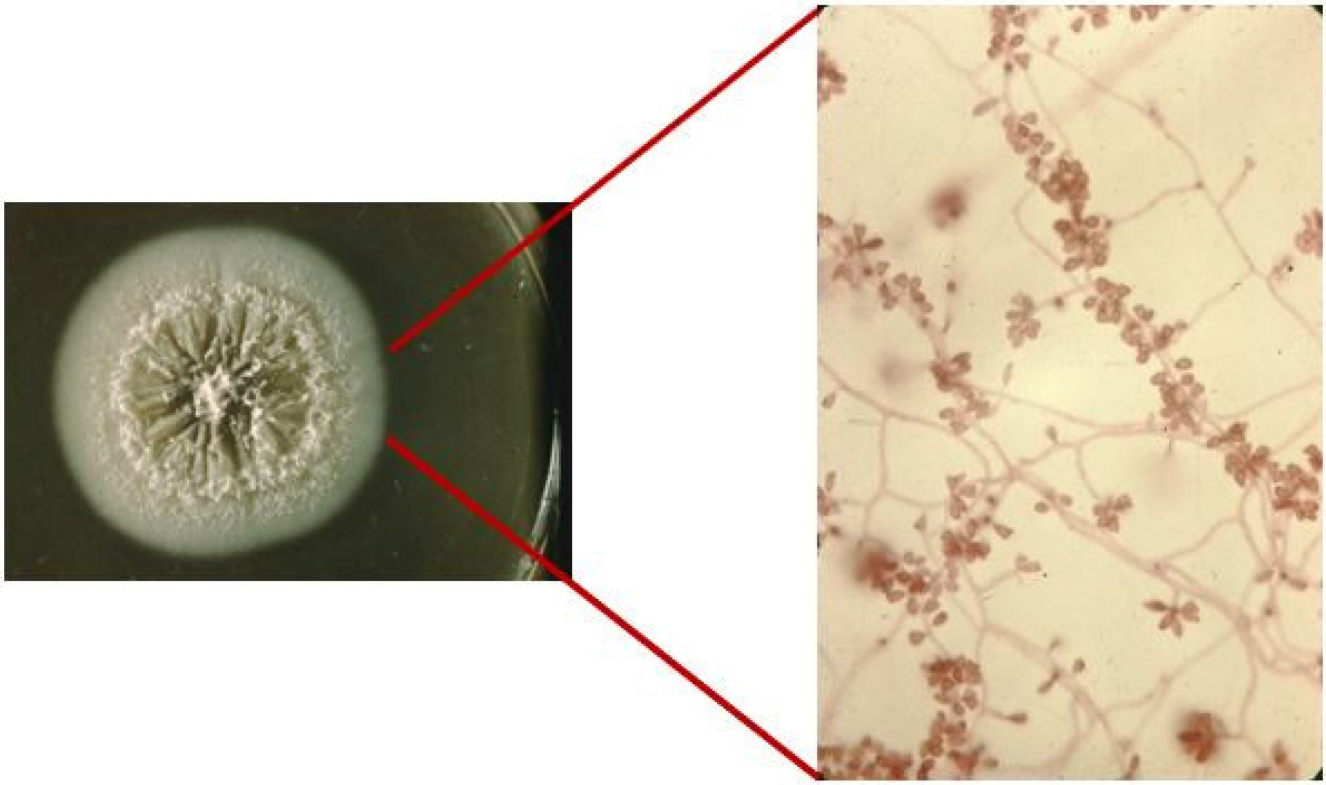

Figure 1. *Sporothrix* spp. culture and erythromycin staining 40×.

As for the clinical forms of sporotrichosis, various types have been described, such as the lymphocutaneous, fixed cutaneous, and, as mentioned earlier, the disseminated or hematogenous forms where both organs and tissues can be affected [5][6][7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28]. The latter is the rarest because the recommended antifungal regimens are usually effective; however, in patients with alterations in cellular immunity, these infections can spread [2][3][4].

2. Epidemiology of Sporotrichosis in North America

A total of 48 publications related to sporotrichosis were found in North America [5][6][7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28][29][30][31][32][33][34][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50][51][52]. There were 1460 patients in total associated with infection caused by species of the genus *Sporothrix*. According to the previous classification, it was found that in Canada, only two case reports were found, one from Ontario and the other from Toronto [5][6]. In the US, 27 reports containing 1 clinical case were found (81.5% *S. schenckii*, 18.5% *Sporothrix* spp., *S. schenckii* complex, and *S. schenckii sensu lato*) [7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28][29][30][31][32][33]. Of these, seven cases came from California, three from Oklahoma, two cases from Kansas, Texas, Arizona, Minnesota, and Florida, one case from Michigan, Nebraska, Oregon, Pennsylvania, and finally, one case without a specific city or region. In Mexico, there were 19 reports registered with 1431

reported cases (84.7% *Sporothrix* spp., 14.47% *S. schenckii*, 0.55% *S. globosa*, 0.21% *S. schenckii* sensu stricto, 0.07% *S. mexicana*) [34][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50][51][52]. Jalisco reported 1060 cases, Guerrero 150, Nayarit 23, Zacatecas 21, Michoacan 20, Guanajuato 14, Oaxaca 9, Puebla, and San Luis Potosí 8 each, Mexico City 6, Chihuahua, Nuevo León, Querétaro, and Veracruz 2 each, Baja California, Durango, State of Mexico, and Morelos 1 each, and 99 cases were reported with an unspecified city (**Table 1**). When classifying according to the current taxonomy [1][2][3][4], researchers can mention that in Canada, 50% of the sporotrichosis was due to *S. schenckii* and 50% to *Sporothrix* spp. [5][6]. In the US, it was reported that *Sporothrix* spp. (85.19%) and *S. schenckii* (14.81%) were responsible for this pathology [7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28][29][30][31][32][33]. Finally, in Mexico, 85.05% were due to *Sporothrix* spp., 14.33% *S. schenckii*, 0.55% *S. globosa,* and 0.07% *S. mexicana* [34][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50][51][52].

Table 1. Epidemiology of Sporotrichosis in North America.

Region	Country	City	Number of Reported Cases	Vulnerable Population		Diagnostic Method	Type of Sporotrichosis	Etiological Agents (%)		References
				Sex	Age (Years)			Taxonomy		
								Before 2017	After 2017	
North America	Canada	Ontario	1	Male	44	PCR sequencing (ITS region)	Disseminated	*S. schenckii*	*S. schenckii*	[5]
		Toronto	1	Male	78	Fungal culture, Biopsy (Histopathology)	Lymphocutaneous	*S. schenckii* complex	*Sporothrix* spp.	[6]
	USA	California	1	Female	7	Fungal culture Biopsy (Histopathology)	Lymphocutaneous	*S. schenckii*	*Sporothrix* spp.	[7]
		Minnesota	1	Male	61	Fungal culture	Disseminated	*S. schenckii*	*Sporothrix* spp.	[8]
		ND	1	Female	87	Fungal culture	Lymphocutaneous on the eyelid	*S. schenckii*	*Sporothrix* spp.	[9]
		Pennsylvania	1	Male	67	Fungal culture Biopsy (Histopathology)	Lymphocutaneous	*S. schenckii*	*Sporothrix* spp.	[10]
		Texas	1	Male	34	Fungal culture Biopsy (Histopathology)	Disseminated	*Sporothrix* spp.	*Sporothrix* spp.	[11]
		Texas	1	Male	9	Fungal culture Biopsy (Histopathology)	Lymphocutaneous on the eyelid	*S. schenckii*	*Sporothrix* spp.	[12]
		California	1	Female	41	Fungal culture	Lymphocutaneous	*S. schenckii*	*Sporothrix* spp.	[13]

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				Sex	Age (Years)			Taxonomy		
								Before 2017	After 2017	
		Oregon	1	Male	53	Fungal culture	Disseminated	*Sporothrix* spp.	*Sporothrix* spp.	[14]
		Oklahoma	1	Male	66	Latex agglutination test	Disseminated	*S. schenckii*	*Sporothrix* spp.	[15]
		Florida	1	Male	33 month-Old	Fungal culture Biopsy (Histopathology)	Atypical lymphadenitis	*S. schenckii*	*Sporothrix* spp.	[16]
		Minnesota	1	Male	49	Fungal culture	Pulmonary sporotrichosis	*Sporothrix* spp.	*Sporothrix* spp.	[17]
		Arizona	1	Male	56	Fungal culture	Lymphocutaneous and disseminated (10 months later)	*S. schenckii*	*Sporothrix* spp.	[18]
		California	1	Male	39	Fungal culture	Sporothrical arthritis	*S. schenckii*	*Sporothrix* spp.	[19]
		California	1	Male	89	Fungal culture Biopsy (Histopathology)	Disseminated	*S. schenckii*	*Sporothrix* spp.	[20]
		Michigan	1	Female	57	Fungal culture Biopsy (Histopathology)	Lymphocutaneous	*S. schenckii*	*Sporothrix* spp.	[21]
		California	1	Male	34	Latex agglutination test	Chronic meningitis	*S. schenckii*	*Sporothrix* spp.	[22]
		Kansas	1	Male	33	Fungal culture MALDI-TOF	Sporothrical arthritis	*S. schenckii*	*Sporothrix schenckii*	[23]
		Oklahoma	1	Male	44	Fungal culture Biopsy (Histopathology)	Pulmonary sporotrichosis	*S. schenckii* sensu lato	*Sporothrix* spp.	[24]
		California	1	Male	41	Fungal culture	Sporothrical arthritis	*S. schenckii*	*Sporothrix* spp.	[25]
		California	1	Female	35	Fungal culture	Disseminated	*S. schenckii*	*Sporothrix* spp.	[26]
		Nebraska	1	Male	62	Fungal culture Biopsy (Histopathology)	Disseminated	*S. schenckii*	*Sporothrix* spp.	[27]

Region	Country	City	Number of Reported Cases	Vulnerable Population		Diagnostic Method	Type of Sporotrichosis	Etiological Agents (%)		References
				Sex	Age (Years)			Taxonomy		
								Before 2017	After 2017	
		Boston	1	Female	35	MALDI-TOF	Fixed cutaneous	*S. schenckii*	*S. schenckii*	[28]
		Kansas	1	Male	30	Fungal culture Biopsy (Histopathology)	Disseminated	*S. schenckii*	*Sporothrix* spp.	[29]
		Florida	1	Male	76	History and physical examination	Lymphocutaneous	*Sporothrix* spp.	*Sporothrix* spp.	[30]
		Oklahoma	1	Male	23	Fungal culture	Lymphocutaneous	*S. schenckii* complex	*Sporothrix* spp.	[31]
		Washington	1	Female	44	Fungal culture PCR sequencing (ITS 1–2)	Disseminated	*S. schenckii*	*S. schenckii*	[32]
		Arizona	1	Female	72	PCR DNA sequencing	Laryngotracheal granulomatous disease	*S. schenckii*	*S. schenckii*	[33]
	Mexico	Veracruz	1	Male	39	Fungal culture Biopsy (Histopathology)	Atypical	*S. schenckii*	*Sporothrix* spp.	[34]
		Puebla	1	Male	36	Fungal culture Biopsy (Histopathology)	Disseminated	*S. schenckii*	*Sporothrix* spp.	[35]
		Oaxaca	1	Male	13	Fungal culture	Lymphocutaneous on the left hand, forearm, and upper arm	*Sporothrix* spp.	*Sporothrix* spp.	[36]
		Mexico City	1	Male	54	Fungal culture Biopsy (Histopathology)	Disseminated (Testicular involvement)	*S. schenckii*	*Sporothrix* spp.	[37]
		Guerrero	1	Female	36	Fungal culture Biopsy (Histopathology)	Disseminated	*Sporothrix* spp.	*Sporothrix* spp.	[38]
		Durango	1	Male	68	Fungal culture Biopsy (Histopathology)	Disseminated	*Sporothrix* spp.	*Sporothrix* spp.	[39]

Region	Country	City	Number of Reported Cases	Vulnerable Population		Diagnostic Method	Type of Sporotrichosis	Etiological Agents (%) Taxonomy		References
				Sex	Age (Years)			Before 2017	After 2017	
		ND	24	Male (16) Female (8)	Average: 35.5	PCR sequencing (calmodulin gene)	Cutaneous disseminated 16 (66.7%) Cutaneous disseminated + Mucosal 3 (12.5%) Joint 1 (4.1%) Visceral 1 (4.1%) Fungaemia 1 (4.1%) Mucosal + Visceral + Fungemia: 1 (4.1%) Visceral + Fungaemia 1 (4.1%)	*S. schenckii* 23 (95.5%). *S. globosa* 1 (4.5%)	*S. schenckii* 23 (95.5%). *S. globosa* 1 (4.5%)	[40]
		ND	55	Male (34) ND Female (18)		Sporotrichin Skin Test Fungal culture	Lymphocutaneous 32 (58.2%) Fixed cutaneous 19 (34.5%) Disseminated 4 (7.3%)	*S. schenckii* 54 (98%) *S. globosa* 1 (2%)	*S. schenckii* 54 (98%) *S. globosa* 1 (2%)	[41]
		Guerrero	73	Male (33) Female (40)	Average: 25.8	Fungal culture Biopsy (Histopathology)	Lymphocutaneous: 41 (56.16%) Fixed cutaneous 24 (32.87%) Disseminated 8 (10.95%)	*S. schenckii*	*S. schenckii*	[42]
		Chihuahua	1	Female	84	Multiplex PCR (Calmodulin gene)	Fixed cutaneous (Auricular sporotrichosis)	*S. schenckii* (sensu stricto)	*S. schenckii*	[43]
		Baja California	1	Male	23	Fungal culture Biopsy (Histopathology)	Lymphocutaneous	*S. schenckii*	*Sporothrix* spp.	[44]
		San Luis Potosi 8 Puebla 3 Mexico City 2 Queretaro 2	22	ND		PCR sequencing (Calmodulin and *calcium-calmodulin-*	Lymphocutaneous: 17 (77.3%) Fixed cutaneous 4 (18.2%) Disseminated 1 (4.5%)	*S. schenckii*: 18 (81.8%) *S. globosa* 4 (18.2%)	*S. schenckii*: 18 (81.8%) *S. globosa* 4 (18.2%)	[45]

schenckii with 42.85% (54/126), and *S. brasiliensis* with 1.59% (2/126) [53][54][55][56][57][58][59][60].

Regarding diagnosis, fungal culture was used as a diagnostic method in all articles (8/8), followed by histopathological examination (5/8). In this case, also, the histopathological examination was always accompanied by fungal cultures. PCR sequencing (2/8) employing the calmodulin gene in one article and the ITS1-2 region in the other was also used as a diagnostic tool. Lastly, diagnosis with microscopy using lactophenol blue was mentioned in two reports (**Table 2**) [53][54][55][56][57][58][59][60].

Table 2. Epidemiology of Sporotrichosis in Central America and the Caribbean.

Region	Country	City	Number of Reported Cases	Vulnerable Population		Diagnostic Method	Type of Sporotrichosis	Etiological Agents (%) Taxonomy		References
				Sex	Age (Years)			Before 2017	After 2017	
Central America	Costa Rica	San José	57 (1994–	No data		Direct microscopy,	ND	*S. schenckii* sensu stricto	*S. schenckii* 53 (93%)	[53]

Region	Country	City	Number of Reported Cases	Vulnerable Population		Diagnostic Method	Type of Sporotrichosis	Etiological Agents (%)		References
				Sex	Age (Years)			Taxonomy		
								Before 2017	After 2017	
			2015)			culture, PCR (enzymatic restriction and sequencing of the calmodulin gen)		53 (93%) *S. brasiliensis* 2 (3.5%) *Sporothrix spp.* 2 (3.5%)	*S. brasiliensis* 2 (3.5%) *Sporothrix spp.* 2 (3.5%)	
	Guatemala	Guatemala City	11	Male 7 Female 4	Average 49 years	Fungal culture, Histopathology	Fixed cutaneous 9 (81.8%) Lymphocutaneous 2 (18.2%)	*Sporothrix* spp. (100%)	*Sporothrix* spp. (100%)	[54]
		Guatemala City	53 (2007–2016)	Male 33 Female 20	Average 44.1 years	Fungal culture, microscope with Lactophenol cotton blue	Lymphocutaneous 33 (62.2%) Fixed cutaneous 17 (32.1%) Disseminated 2 (3.8%) Chancre 1 (1.9%)	*Sporothrix schenckii* complex. (100%)	*Sporothrix* spp. (100%)	[55]
		Guatemala City	1	ND		Fungal culture, PCR sequencing (ITS 1- 2 and β -tubulin)	ND	*Sporothrix schenckii* sensu stricto	*Sporothrix schenckii*	[56]
	Honduras	Tegucigalpa	1	Male 1	14 years	Fungal culture	Lymphocutaneous 1 (100%)	*S. schenckii*	*Sporothrix* spp.	[57]
	Panamá	Chorrera District	1	Male 1	34 years	Clinical, Direct Microscopy, Fungal culture.	Lymphocutaneous 1 (100%)	ND	*Sporothrix* spp.	[58]
		Pinar del Río	1	Female 1	57 years	Histopathology Fungal culture	Lymphocutaneous	*Sporothrix schenckii* sensu lato (100%)	*Sporothrix* spp. (100%)	[59]
Caribbean	Cuba	Cumanayagüa	1	Male	67	Histopathology, Fungal culture, Microscopy with Lactophenol cotton blue and calmodulin gene)	Lymphocutaneous	*Sporothrix schenckii* sensu lato	*Sporothrix* spp. (100%)	[60]

[61][62][63][64][65][66][67][68][69][70][71][72][73][74][75][76][77][78][79][80][81][82][83][84][85][86][87][88][89][90][91][92][93][94][95][96][97][98][99][100][101][102][103][104][105][106][107][108][109][110][111][112][113][114][115][116][117][118][119][120][121][122][123][124][125][126][127][128][129][130][131]

4 reports

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stricto (23.08%), 26 by *S. brasiliensis* (68.52%), 1 by *S. globosa* (2.6%), 1 by *S. schenckii* (2.6%), and 1 by *S. schenckii complex* (2.6%) [61][62][63][64]. Brazil reported 42 articles with 5546 analyzed cases [65][66][67][68][69][70][71][72][73][74][75][76][77][78][79][80][81][82][83][84][85][86][87][88][89][90][91][92][93][94][95][96][97][98][99][100][101][102][103][104][105][106], identifying *Sporothrix* spp. and *S. schenckii* complex as the causative agent in 4906 cases (88.46%), *S. schenckii* in 302 (5.45%), *S. brasiliensis* in 125 (2.25%), *Sporothrix* sensu lato in 110 (1.98%), *S. globosa* plus *S. schenckii* in 91 cases (1.64%) *Sporothrix* sensu stricto in 5 (0.09%), *S. globosa* in 4 (0.07%), and *S. mexicana* in 3 (0.05%) during the studied period. In Colombia, 4 reports were found, adding up to 50 cases [56][107][108][109].*S. Schenckii* sensu stricto was identified in 22 cases (44.00%), *Sporothrix* spp. in 15 (30.00%), *S. globosa* in 12 (24.00%) and S. *schenckii* sensu lato in 1 (2.00%). Likewise, in Chile, 3 reported cases detected *Sporothrix* spp. in 1 (33.33%), *S. globosa* in 1 (33,33%), and *Sporothrix pallida* in 1 (33.33%) [110][111][112]. A total of 13 cases of *Sporothrix* spp. and *S. schenckii* complex (100%) were reported in Paraguay [113][114]. In Peru, from 4792 cases, *S. schenckii* was found in 4656 (97.16%), *Sporothrix* spp. and the *Sporothrix* complex in 116 (2.42%), *S. schenkii* sensu stricto in 19 (0.40%), and *Sporothrix* sensu lato in 1 (0.02%) [115][116][117][118][119][120][121][122][123]. There was 1 report of 157 cases of *Sporothrix* spp. (100%) found in Uruguay [124]. Finally, there were 4 reports from Venezuela with 452 cases of *Sporothrix* spp., and the *Sporothrix* complex was found in 220 of those cases

ND: Not Determined

Region	Country	City	Number of Reported Cases	Vulnerable Population		Diagnostic Method	Type of Sporotrichosis	Etiological Agents (%)		References
				Sex	Age (Years)			Taxonomy		
								Before 2017	After 2017	
		ND	18	Male (10) Female (8)	ND	PCR sequencing (ITS regions)	Lymphocutaneous 13 (72.2%) Fixed cutaneous 5 (27.8%)	*S. schenckii* 17 (94.4%) *S. globosa:* 1 (5.6%)	*S. schenckii* 17 (94.4%) *S. globosa:* 1 (5.6%)	[51]
		Oaxaca	2	Male	61	Multiplex PCR (Calmodulin gene) [61][62][63][64]	Fixed cutaneous	*S. schenckii* sensu stricto	*S. schenckii*	[52]
				Male	21		Disseminated 1 (50%)			

ND: Not Determined.

to in 17 6%) [125] [126][127][128]

Regard siliensis, 2.63% *S. g* c agent was *Sporothr* 64%, *S. schenckii* 0.41%, *S. globosa* 0.07%, and *S. mexicana* 0.05% [65][66][67][68][69][70][71][72][73][74][75][76][77][78][79][80][81][82][83][84][85][86][87][88][89][90][91][92][93][94][95][96][97][98][99][100][101][102][103][104][105][106]. In Colombia, *S. schenckii* 44.00%, *Sporothrix* spp. 32.00%, and *S. globosa* 24.00% were the principal mycotic agents [56][107][108][109]. Regarding Chile, the pathogenic agents were *Sporothrix* spp., *S. globose*, and *S. pallida* (33.33% each) [110][111][112]. In Paraguay, the unique agent found was *Sporothrix* spp. (100%) [113][114]. For Peru, the most important pathogenic agents were *Sporothrix* spp. (99.54%), and *S. schenckii* (0.46%) [115][116][117][118][119][120][121][122][123]. In Uruguay, 100% of the cases were due to *Sporothrix* spp. (100%) [124]. In Venezuela, *Sporothrix* spp. (80.04%), *S. schenckii* (13.38%), and *S. globose* (6.57%) were the types of *Sporothrix* agents [125][126][127][128].

The most frequent types of disease were lymphocutaneous with 3293 cases (29.47%), fixed cutaneous with 1947 (17.43%), disseminated cutaneous with 34 (0.30%), systemic form with 18 (0.16%), and others with 177 cases (1.60%). However, there were 5702 cases (51.04%) with undetermined types from all the cases diagnosed as sporotrichosis [56][61][62][63][64][65][66][67][68][69][70][71][72][73][74][75][76][77][78][79][80][81][82][83][84][85][86][87][88][89][90][91][92][93][94][95][96][97][98][99][100][101][102][103][104][105][106][107][108][109][110][111][112][113][114][115][116][117][118][119][120][121][122][123][124][125][126][127][128].

The most common reported etiological agent with the new taxonomical classification was *Sporothrix* spp. with 95.12% (10,511/11,050), followed by *S. schenckii* with 1.23% (136/11,050), *S. brasiliensis* with 2.27% (251/11,050), *S. globosa* plus *S. schenckii* with 0.82% (91/11,050), *S. globosa* with 0.52% (57/11,050), *S. mexicana* 0.027% (3/11,050), and *S. pallida* with 0.009% (1/11,050) [56][61][62][63][64][65][66][67][68][69][70][71][72][73][74][75][76][77][78][79][80][81][82][83][84][85][86][87][88][89][90][91][92][93][94][95][96][97][98][99][100][101][102][103][104][105][106][107][108][109][110][111][112][113][114][115][116][117][118][119][120].

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