

# Epidemiological, clinical and laboratorial aspects of sporotrichosis, an emerging zoonosis in Brazil

## Abstract

*Sporothrix schenckii* is a dimorphic fungus that can cause sporotrichosis. *S. schenckii* exists in hyphal form at temperatures below 37°C or as yeast at temperatures equal to or above 37°C. Different strains of *S. schenckii* have been identified, with the *S. schenckii* complex being the most commonly found in America, Asia, and Africa. The *S. brasiliensis*, found in Brazil, is known to be transmitted by infected cats. Feline sporotrichosis is a subcutaneous mycosis caused by dimorphic fungi of the genus *Sporothrix*. In cats, it manifests clinically as cutaneous nodules, nasal discharge, and generalized ulcerative lesions. In humans, *sporotrichosis* is classified as cutaneous, mucosal, osteoarticular, systemic, immunoreactive, and mixed localized, with the cutaneous form being the most common. It is a zoonosis increasingly reported in Brazil. Strategies for managing the disease include early diagnosis, isolation and treatment of infected cats, control of stray animal populations, and public health education on responsible pet ownership.

**Keywords:** Sporotrichosis, dimorphic fungus, zoonotic disease, humans, cats

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## Introduction

The genus *Sporothrix* consists of dimorphic, saprophytic, and cosmopolitan fungi found in soil and plant debris, particularly in humid temperate and tropical regions. This genus includes several species, such as *Sporothrix brasiliensis*, *Sporothrix globosa*, *Sporothrix mexicana*, and *Sporothrix luriei*, with *Sporothrix brasiliensis* being the most prevalent in Brazil.<sup>1,2</sup>

Sporotrichosis is a zoonotic disease that affects various species, including felines, humans, horses, dogs, pigs, and cattle. Domestic cats play a significant role in the spread of the disease, especially unneutered males with access to the outdoors.<sup>3,4</sup>

In Brazil, sporotrichosis is considered an emerging disease, with a higher incidence in regions with low socioeconomic conditions, which hinders access to diagnosis and appropriate treatment.<sup>5</sup>

Treatment is usually expensive, and few municipal governments provide resources for managing the disease in animals.<sup>6,7</sup>

## Epidemiology

Sporotrichosis is described worldwide, with most cases reported in the tropical and subtropical regions of Americas. Gardeners, farmers, miners, horticulturists, and armadillo hunters have an increased risk of infection, since *S. schenckii* can be isolated from soil, plants, or plant products.<sup>8</sup>

Infection can also occur during animal-to-human transmission through scratches or bites from infected cats.<sup>9</sup> Since reporting the disease is not always mandatory, a comprehensive epidemiological assessment is compromised.<sup>10</sup>

The importance of domestic cats in the zoonotic transmission of sporotrichosis was first reported in the United States of America (USA) in 1982, and subsequently in Brazil in the states of São Paulo (SP), Rio de Janeiro (RJ), and Rio Grande do Sul (RS). In Brazil, between 1992 and 2015, there were 782 hospitalizations and 65 deaths. HIV co-infection occurred in 6% of hospitalizations and 40% of deaths. The states with the highest number of hospitalizations were Rio de Janeiro (32%), São Paulo (16.4%), and Goiás (8.8%).

Regarding deaths, 55.4% were reported in Rio de Janeiro, 18.5% in Minas Gerais, 9.2% in São Paulo, 6.2% in Rio Grande do Sul, 3.1% in Paraná, and 1 death each in Bahia, Goiás, Pará, Santa Catarina, and Sergipe.<sup>11</sup>

In the State of Rio de Janeiro, particularly in the metropolitan region, the disease came to be considered hyperendemic starting in the late 1990s. Between 2013 and 2020, following the implementation of mandatory reporting, more than 12,000 cases in animals and approximately 9,500 cases in humans were officially documented.<sup>10</sup> From 2013 to 2020, more than 12,000 cases were documented in animals and approximately 9,500 cases in humans, consolidating the State of Rio de Janeiro as the national epicenter. In the Municipality of Rio de Janeiro, between January 2023 and May 2024, 1,567 cases of animal sporotrichosis were reported, with felines being the most affected species, representing 97% of the cases. In the state of São Paulo, between 1956 and 2001, 51 cases were identified in cats and 15 in human patients infected by cats. From 2011 to 2021, 3,717 cats were diagnosed with sporotrichosis in the city of São Paulo.<sup>10,11</sup>

In recent years, states in the Brazilian Northeast, such as Pernambuco, Alagoas, and Rio Grande do Norte, have detected epizootic events in feline population with zoonotic transmission. Starting in 2018, outbreaks and official records began to receive more attention in the Northeast of Brazil, in cities such as Recife, João Pessoa, and Natal, which registered a significant increase in cases among semi-domiciled cat populations. In 2020, all Brazilian states, except Roraima, had published cases of human sporotrichosis. In 2025, in Natal, Rio Grande do Norte, 2,328 cases of sporotrichosis in cats were reported, with 1,639 confirmed cases. In Recife, Pernambuco, an epidemiological outbreak was reported with 59 confirmed cases of feline sporotrichosis in the metropolitan region.<sup>10</sup>

In dogs, sporotrichosis manifests as chronic, non-healing skin lesions located on the head, muzzle, and trunk. Unlike cats, the localized cutaneous form or nodular lymphangitis is more common, and the disease is generally less severe and progresses more slowly. Dogs are considered accidental hosts and do not play a significant role in maintaining or transmitting the epidemic, presenting less zoonotic potential compared to felines. In Brazil, cases of canine sporotrichosis

are concentrated in urban areas, particularly in the metropolitan region of Rio de Janeiro and the state of São Paulo.<sup>1,2,4,5</sup>

In Rio de Janeiro in 2008, 1,503 cats and 64 dogs were reported to be affected by the fungus, leading to a ratio of approximately one infected dog for every 25 cases in cats. Dogs present a low fungal load in their lesions and generally become infected after fights with infected felines, or when used for hunting, showing signs of the disease due to lesions caused by tree trunks and branches.<sup>2</sup>

In horses, infection occurs primarily through traumatic inoculation of fungi present in vegetation with thorns or wood splinters. In horses, sporotrichosis manifests as subcutaneous nodules located mainly on the limbs. The nodules tend to follow the path of the lymphatic vessels and can develop into ulcers and fistulas that are difficult to cicatrization. The nodules are classically referred to as a “sporotrichotic rosary.” Thee, sporotrichosis in horses is considered an occupational disease related to handling and work in the field, and not has zoonotic relevance.<sup>4</sup>

Notification of sporotrichosis in animals is not mandatory throughout the entire Brazilian national territory, but it has become mandatory in several states, such as Sergipe (state law of 2025) and Rio de Janeiro (Resolution SES no. 3664 of July 10, 2025), and in the Municipality of São Paulo (ordinance no. 470/2020-SMS.G).

In humans, sporotrichosis has been included in the National List of Compulsory Notification, with mandatory registration in the Notifiable Diseases Information System (SINAN) starting in 2026.

## Transmission

Until the end of 1970s, the disease was common among gardeners, farmers, or people who had contact with plants and soil in natural environments where the fungus was present in organic materials, and was considered an occupational disease.<sup>12</sup> Transmission through bites or scratches, mainly from cats (*Felis catus*), which can carry large amounts of yeast between their claws, and their close contact with humans, has allowed sporotrichosis to be characterized as a zoonosis, primarily affecting families with unfavorable infrastructure and socioeconomic conditions and with sick cats at home, as well as affecting veterinarians and their assistants.<sup>13</sup>

## Sporotrichosis in felines

In cats, the fungus is primarily transmitted through skin trauma. Cats become infected due to their natural behaviors of digging in the soil, covering their feces, and sharpening their claws on wood surfaces contaminated with *S. schenckii*.<sup>14</sup>

Young, unneutered male cats of reproductive age are more prone to contracting and transmitting the disease through fights over territory and competition for females.<sup>15</sup>

The presence of firm nodules in the subcutaneous tissue in regions such as the head, tail, and limbs are some of the typical signs of sporotrichosis in felines. These nodules develop ulcerations that begin to release a seropurulent exudate. Multiple nodular lesions in the subcutaneous tissue, accompanied by ulcers and crusts, with greater involvement of nasal region, are characteristic of lymphocutaneous or systemic forms (Figure 1). In addition to localized cutaneous involvement, sporotrichosis can also manifest clinically in lymphocutaneous, systemic, and extracutaneous forms. Extracutaneous lesions affect the lungs, liver, spleen, kidneys, and bones.<sup>7,9</sup>



**Figure 1** Sporotrichosis in cats.

Ulcerative lesions on the head of a cat with sporotrichosis.

## Clinical forms in humans

Sporotrichosis has an incubation period that varies from a few days to three months after human exposure. Infections can be classified as cutaneous (lymphocutaneous, fixed cutaneous, and multiple inoculation involvement), mucosal (ocular and nasal involvement), osteoarticular (arthritis/tenosynovitis/infectious osteomyelitis), systemic (cutaneous/mucosal, osteoarticular, pulmonary, neurological involvement, and sepsis), immunoreactive (erythema nodosum, erythema multiforme, Sweet's syndrome, and reactive arthritis), and localized mixed (cutaneous mucosal, cutaneous osteoarticular, and cutaneous immunoreactive forms).<sup>16</sup>

In cutaneous sporotrichosis, the initial lesions are erythematous papulonodular lesions (Figure 2A) that may be smooth or verrucous and involve the lymphatic channels. The lesions are painless, even after ulceration<sup>17</sup> (Figure 2).



**Figure 2** Clinical forms of sporotrichosis.

A. Cutaneous sporotrichosis.

B. Fixed cutaneous sporotrichosis.

C. Multiple inoculation sporotrichosis.

Lymphocutaneous sporotrichosis is considered the most common clinical form, representing 46% to 92% of cases.<sup>18</sup> Clinically, it begins with the appearance, days or months after the trauma, of an erythematous papule or pustule at the site of fungal inoculation, called a sporotic or inoculation chancre (Figure 2B). After a few days or weeks, new papulonodular, erythematous, rosary-shaped lesions appear along the regional lymphatic pathway.<sup>18,19</sup>

Fixed cutaneous sporotrichosis is the second most frequent clinical form, accounting for 25% of cases. After trauma, the initial lesion may evolve into ulceration, with irregular borders and varying sizes, or into a verrucous appearance, with or without perforations for drainage of purulent material.<sup>20,21</sup>

In multiple inoculation sporotrichosis, multiple polymorphic skin lesions are observed in non-contiguous locations, without systemic involvement (Figure 2C). This clinical form gained prominence with the emergence of zoonotic cases related to sick cats, with the occurrence of multiple traumas caused by scratches and bites.<sup>22</sup>

Osteoarticular sporotrichosis is the most common clinical manifestation after skin and mucous membrane involvement. Osteoarticular involvement usually occurs from a contiguous skin lesion and is often unifocal. These lesions occur on the extremities, especially hands and feet, due to the anatomical proximity between the skin and osteoarticular system and osteometabolic fragility, particularly in the elderly or chronic users of corticosteroids; and due to wounds caused by cat bites, which cause greater inoculum depth.<sup>23,24</sup>

In pulmonary sporotrichosis, symptoms include cough, low-grade fever, or weight loss. Risk factors for pulmonary sporotrichosis include middle-aged humans with chronic lung problems, alcohol abuse or history of steroid use, diabetes mellitus, sarcoidosis, and immunosuppression.<sup>25-27</sup>

Patients with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), with CD4 T lymphocyte counts <200 cells/mm<sup>3</sup>, malnourished individuals, alcoholics, diabetics, transplant recipients, patients with hematological malignancies, and those on chronic immunosuppressive drugs or immunobiologics are more predisposed to developing systemic forms of disease and may die.<sup>28,29</sup>

Ocular sporotrichosis usually presents as chronic granulomatous lesions on eyelid and sclera, in the form of erythematous and hardened nodules or ulcers that can mimic chalazion, hordeolum, or neoplastic conditions.<sup>30</sup> In rare cases, especially in immunocompromised patients, intraocular involvement may occur, such as uveitis or choroiditis, which can lead to visual impairment.<sup>31</sup>

Although any mucous membrane can be affected by *Sporothrix spp.*, the ocular mucosa is the most commonly affected. The close proximity between humans and domestic cats has increased the frequency of this clinical presentation, especially in children. This usually occurs when animals sneeze, aerosols reach the human ocular mucosa, or, after contact with the animal or fomites, individuals bring contaminated hands to their eyes.<sup>32</sup> The characteristic clinical picture is granulomatous conjunctivitis, with vegetating lesions in palpebral/bulbar conjunctiva, enanthema, and purulent discharge.<sup>33</sup>

Central nervous system involvement is a rare and serious condition that occurs in more invasive forms of disease, particularly those associated with HIV/AIDS or the use of immunobiologics, with dissemination of the fungus across the blood-brain barrier.<sup>34</sup> Some *Sporothrix* species exhibit greater virulence with neurotropism, especially *S. brasiliensis*. In neurological sporotrichosis, meningitis with hydrocephalus may occur.<sup>35</sup>

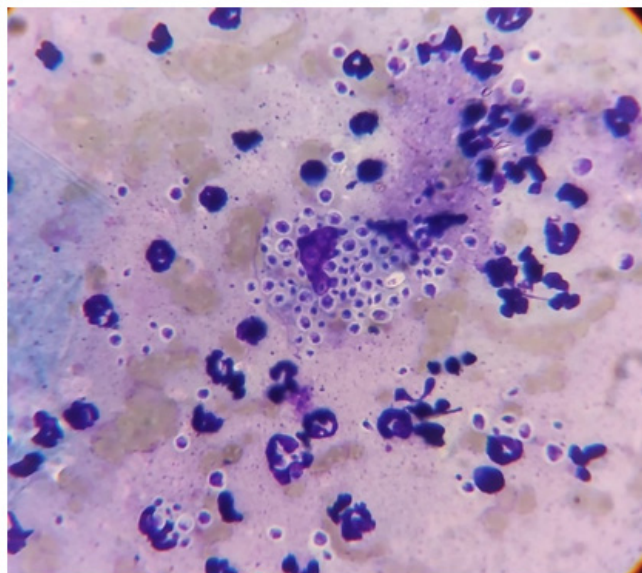
## Diagnosis

In practice, any tissue material is suitable, although suppurative or purulent material is best for diagnosis, and can be obtained by needle aspiration of abscesses or by deep manual pressure on the lesions, especially after removal of the wound crust.<sup>16</sup>

The material can also be collected by biopsy using a punch or scalpel to obtain a fusiform biopsy, a method used in both humans<sup>25,36</sup> and felines.<sup>37</sup> The *S. schenckii* manifests as round or oval budding yeasts with a narrow base in human and animal tissues.<sup>37</sup> The depth of the biopsy is essential for correct diagnosis and must reach the subcutaneous tissue.

The gold standard for identifying *Sporothrix spp.* is fungal culture, which produces creamy, clear colonies with an irregular appearance. Cultivation on Sabouraud dextrose agar and Mycosel agar makes *Sporothrix* colonies visible in 3 to 6 days at 25°C to 28°C from skin lesion samples, and in 10 to 19 days using other biological materials.<sup>38</sup>

Impression cytology or fine-needle aspiration cytology is widely used in felines, revealing small yeast-like structures, oval, spherical or cigar-shaped, typically surrounded by a thin, clear halo in the cytoplasm<sup>39</sup> (Figure 3).



**Figure 3** Cytological examination.

Material stained using the Romanowsky method. Presence of yeast-like structures compatible with fungi from *Sporothrix spp.* complex (100x).

The intradermal test (sporotrich M) corresponds to a delayed hypersensitivity reaction using crude antigen obtained from cultures of *S. schenckii* in mycelial stage. It has a sensitivity of 94.5% and a specificity of 95.2%, and allows for a presumptive diagnosis, as well as indicating previous exposure to *Sporothrix spp.* It is used in epidemiological investigations in endemic areas.<sup>40</sup>

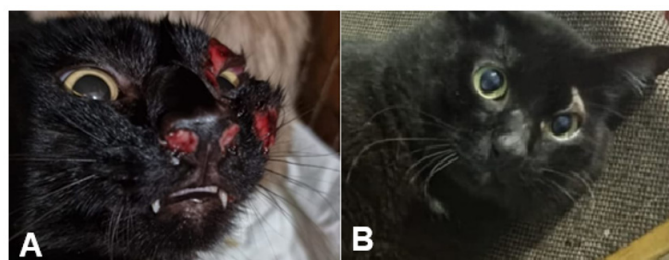
Enzyme-linked immunosorbent assay (ELISA) and immunoblotting are more sensitive and provide faster results. ELISA uses the SsCBF antigenic fraction (Concanavalin-A binding fraction of *S. schenckii*), having a specificity of 90% and a sensitivity of 80%, and can use different biological samples, such as blood, synovial fluid, and cerebrospinal fluid.<sup>41</sup> ELISA using exoantigens from *S. brasiliensis*, despite its simple methodology, presents variations in results.<sup>42</sup>

Other molecular diagnostic methods include detection by polymerase chain reaction (PCR),<sup>43</sup> DNA sequencing,<sup>44</sup> polymerase chain reaction with restriction fragment length polymorphism (RFLP-PCR; CAL-RFLP with HhaI enzyme),<sup>45</sup> species-specific PCR with rolling circle amplification (RCA)<sup>46</sup> randomly amplified polymorphic DNA (RAPD),<sup>47</sup> amplified fragment length polymorphism (AFLP),<sup>33</sup> and qPCR.<sup>48</sup>

In cats, the differential diagnosis of sporotrichosis includes diseases such as squamous cell carcinoma, cutaneous lymphoma, cutaneous fibrosarcoma, bacterial abscesses, cutaneous leishmaniasis, nocardiosis, eosinophilic dermatitis, cryptococcosis and histoplasmosis.<sup>7,14</sup>

## Treatment

The choice of medication to the treatment of sporotrichosis is based on the severity and location of the lesions, the patient's clinical picture, drug interactions, adverse events, systemic involvement, and the specific *Sporothrix* species involved. Itraconazole, potassium iodide, terbinafine, and amphotericin B are available in Brazil for the treatment of feline sporotrichosis, with itraconazole being the preferred choice as a first-line antifungal (Figure 4). Treatment should be completed without interruption, except in cases of adverse drug reactions, where temporary interruption of therapy is necessary. The dose of itraconazole should be 100 mg/cat for animals weighing more than 3 kg, 50 mg/cat for animals weighing 1-3 kg, and 10 mg/kg for cats weighing less than 1 kg, orally, daily, for a period of two to six months.<sup>1,38</sup>



**Figure 4** Mixed-breed cat with sporotrichosis on the face.

A. Disseminated cutaneous sporotrichosis on the face characterized by ulcerative, exudative, and crusted lesions on the nasal, periorbital region and face.

B. Complete lesion involution after treatment with itraconazole at a dose of 100mg/cat/24 hours orally during six months.

In cats, the combination of itraconazole, at dose 2.5-5 mg/kg/day, orally, or 10 mg/kg/day, orally with potassium iodide, at dose 20 mg/kg/day/twice day, orally is indicated for felines with disseminated skin lesions, respiratory conditions, disease recurrence, and cases refractory to monotherapy. The average time to clinical cure in animals treated with itraconazole combined with potassium iodide is 11 weeks, but can vary from four to six months. Due to the risk of intoxication (iodism) in felines, its use has decreased over the years.<sup>7</sup>

Another therapeutic option, although for restricted hospital use, is intralesional amphotericin B (concentration of 5mg/ml) combined with itraconazole (5-10 mg/kg/day, orally) and potassium iodide (2,5-20 mg/kg/day, orally), mainly in cases of persistent respiratory lesions.<sup>7,14</sup>

In dogs, sporotrichosis can be treated with itraconazole (10 mg/kg/day, orally) or ketoconazole (5-10 mg/kg/day, orally), and in cases of therapeutic failure, potassium iodide (40 mg/kg, two to three times daily, orally) can be used in dogs in combination with itraconazole or ketoconazole during 14 to 30 weeks.<sup>49</sup>

In horses, treatment of sporotrichosis involves the use of sodium iodide (20% saturated solution, 20-40 mg/kg/day intravenously for 2 to 5 days, followed by daily oral administration (20-40 mg/kg) until clinical cure is achieved. Ethylenediamine dihydroiodide (EDDI), an animal feed supplement and organic iodide powder, is another option due to its cost and ease of administration.<sup>50</sup> A resume of treatment of cats, dogs, and horses are summarized in Table 1.

In humans, in addition to itraconazole, fluconazole, terbinafine, ketoconazole, amphotericin B, and potassium iodide can be used.<sup>39,51</sup> For the treatment of severe and disseminated forms of sporotrichosis in humans, the Brazilian Unified Health System (SUS), through the Secretariat of Health and Environment Surveillance (SVSA), offers free the itraconazole and amphotericin B lipid complex.

**Table 1** Main treatment methods for sporotrichosis in animals

Species	Feline	Canine	Equine
Itraconazole	Cats with <1 kg, 10 mg/kg/day, orally Cats between 1-3 kg, 50 mg/cat/day, orally Cats above >3 kg, 100 mg/cat/day, orally	10 mg/kg/day, orally	
Ethylenediamine dihydroiodide			Attack dose: 1-2 mg/kg twice day during 7-10 days; followed 0.5-1.0 mg/kg twice day during 1 month after resolution of clinical signs
Sodium iodide			20% saturated solution, 20-40 mg/kg/day intravenously during 2-5 days, followed by daily oral administration (20-40 mg/kg) until clinical cure is achieved
Itraconazole + Potassium iodide	2.5-5 mg/kg/ twice day, orally or 10mg/kg/day, orally +20mg/kg/day, twice day, orally	10 mg/kg/day, orally + 40 mg/kg, twice day or three times a day, orally	
Ketoconazole		5-10 mg/kg/day, orally	
Ketoconazole + Potassium iodide		5-10 mg/kg/day + 40 mg/kg, two to three times daily, orally	
Amphotecin B + Itraconazole + potassium iodide	Concentration 5mg/ml, Intralesional + 5-10 mg/kg/day, orally + 2,5-20 mg/kg/day, orally		

## Conclusion

Cats are the primary hosts, especially unneutered adult male cats with access to contaminated environments. Transmission can occur through direct contact with the fungus in nature, through contaminated soil or plant material, through enzootic horizontal transmission (from cat to cat/from cat to dog), and through zoonotic horizontal transmission (from cat to human) via scratches, bites, or contact with the lesions of an infected cat. Given its importance to animal and human health, it is necessary to adopt a series of strategies for managing the disease. These include accurate diagnosis, isolation, and treatment of infected cats; control of stray animal populations; and public health education on responsible pet ownership.

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None.

## Conflicts of interest

The authors declares that there are no conflicts of interest.

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