

Coccidioidomycosis in South America: a rare or a neglected disease entity?

Marcus Teixeira

University of Brasilia – Tropical Medicine Institute

**Northern Arizona University – Pathogen and
Microbiome Institute**



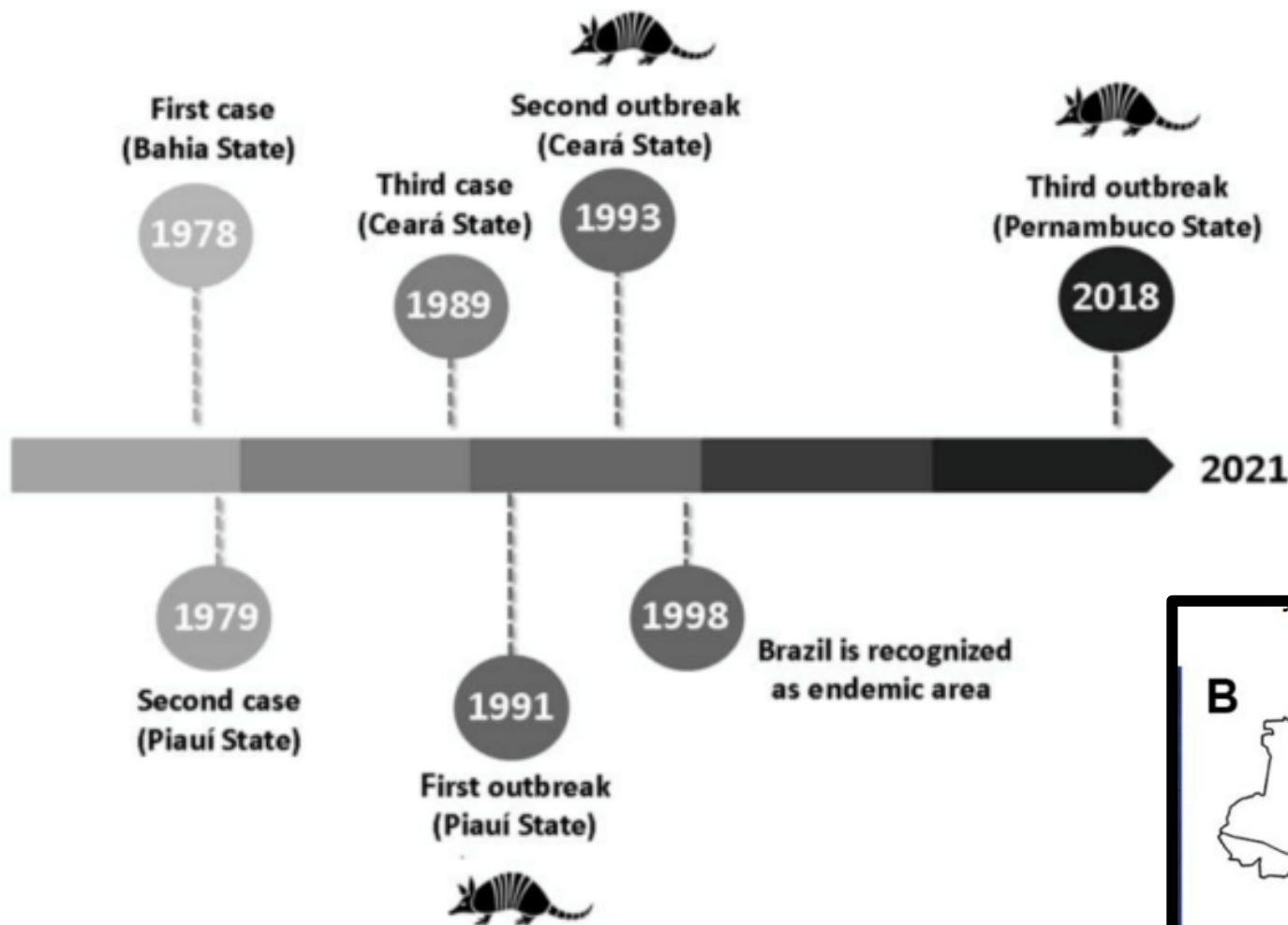
© Samuel Morais

Defining the epidemiological range of paracoccidioidomycosis and coccidioidomycosis in Northeast Brazil - **CNPq/Universal – grant # 301301/2014-0**

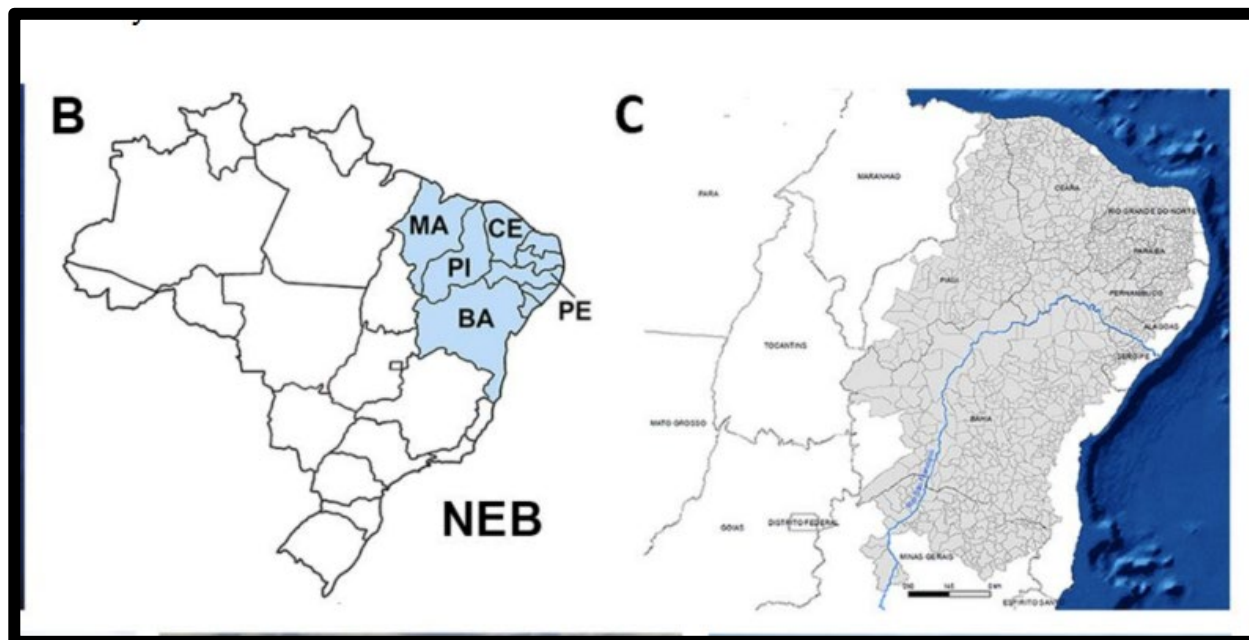
Specific Aims

- Retrospective/prospective study of clinical cases of PCM and CM in the Northeast (North) of Brazil;
- Soil collection from armadillos burrows and molecular detection of *Paracoccidioides* sp. and *Coccidioides* sp.
- Metagenomics study of positive and negative samples for both species;
- Predictive species distribution modeling (or niche modeling) of *Paracoccidioides* sp. and *Coccidioides* sp. using molecular and epidemiological data (random forest and artificial neural networks);

B



Coccidioides and mammalian and hosts



Common host in South America – The armadillo



The endozoan, small-mammal reservoir hypothesis and the life cycle of *Coccidioides* species

John W Taylor ✉, Bridget M Barker

Medical Mycology, Volume 57, Issue Supplement_1, 1 February 2019, Pages S16–S20, <https://doi.org/10.1093/mmy/myy039>

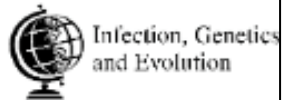
Published: 25 January 2019 **Article history** ▼



Available online at www.sciencedirect.com

SCIENCE @ DIRECT®

Infection, Genetics and Evolution 6 (2006) 344–351



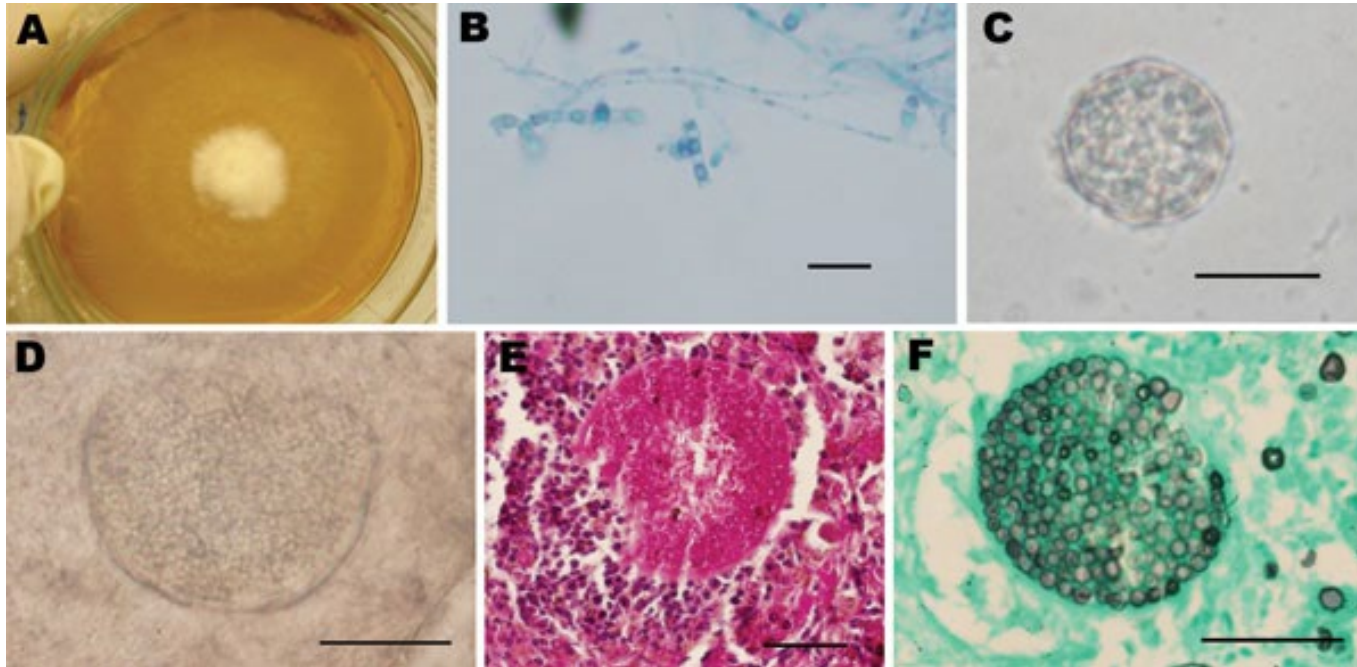
www.elsevier.com/locate/meegid

Phylogenetic and evolutionary aspects of *Paracoccidioides brasiliensis* reveal a long coexistence with animal hosts that explain several biological features of the pathogen

Eduardo Bagagli ^{a,*}, Sandra M.G. Bosco ^a, Raquel Cordeiro Theodoro ^a, Marcello Franco ^b

Coccidioides posadasii Infection in bats, Brazil

Cordeiro et al, EID vol 18. Nº4, april 2012



- Analyze the eco-epidemiologic aspects of *Histoplasma capsulatum* in Northeast Brazil;
- *H. capsulatum* was not isolated;
- *Coccidioides posadasii* was recovered from *Carollia perspicillata* bat lungs.
- Immunologic studies detected coccidioidal antibodies and antigens in *Glossophaga soricina* and *Desmodus rotundus* bats.



Carollia perspicillata

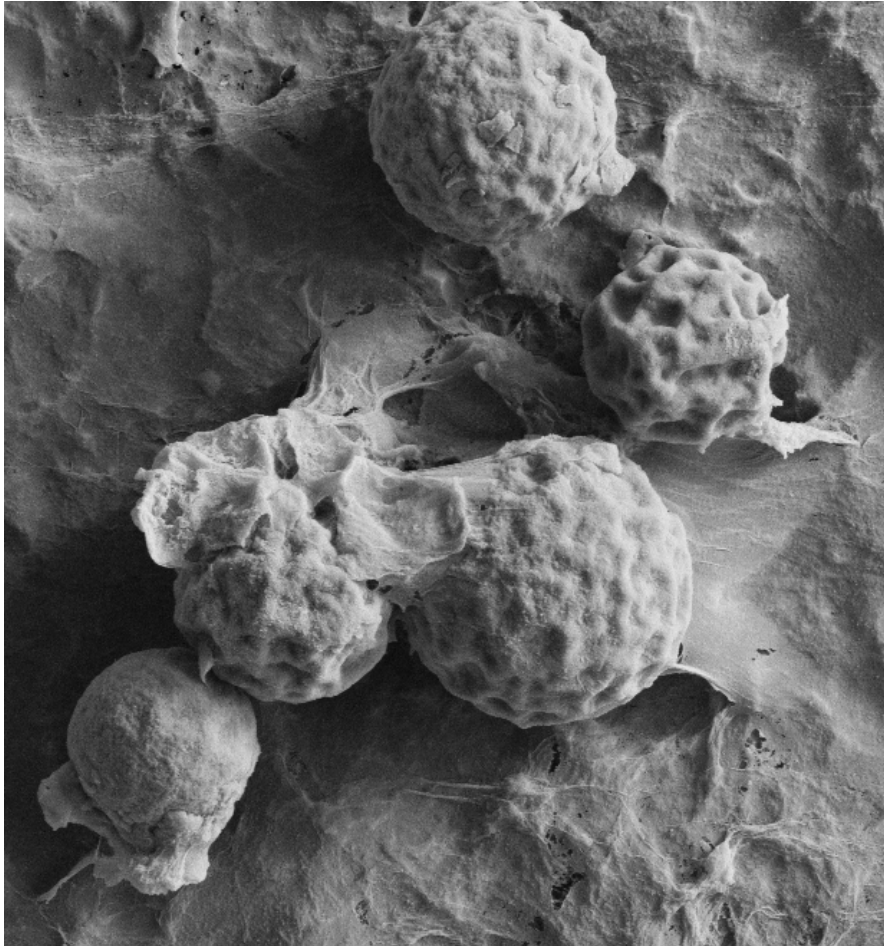


Glossophaga soricina

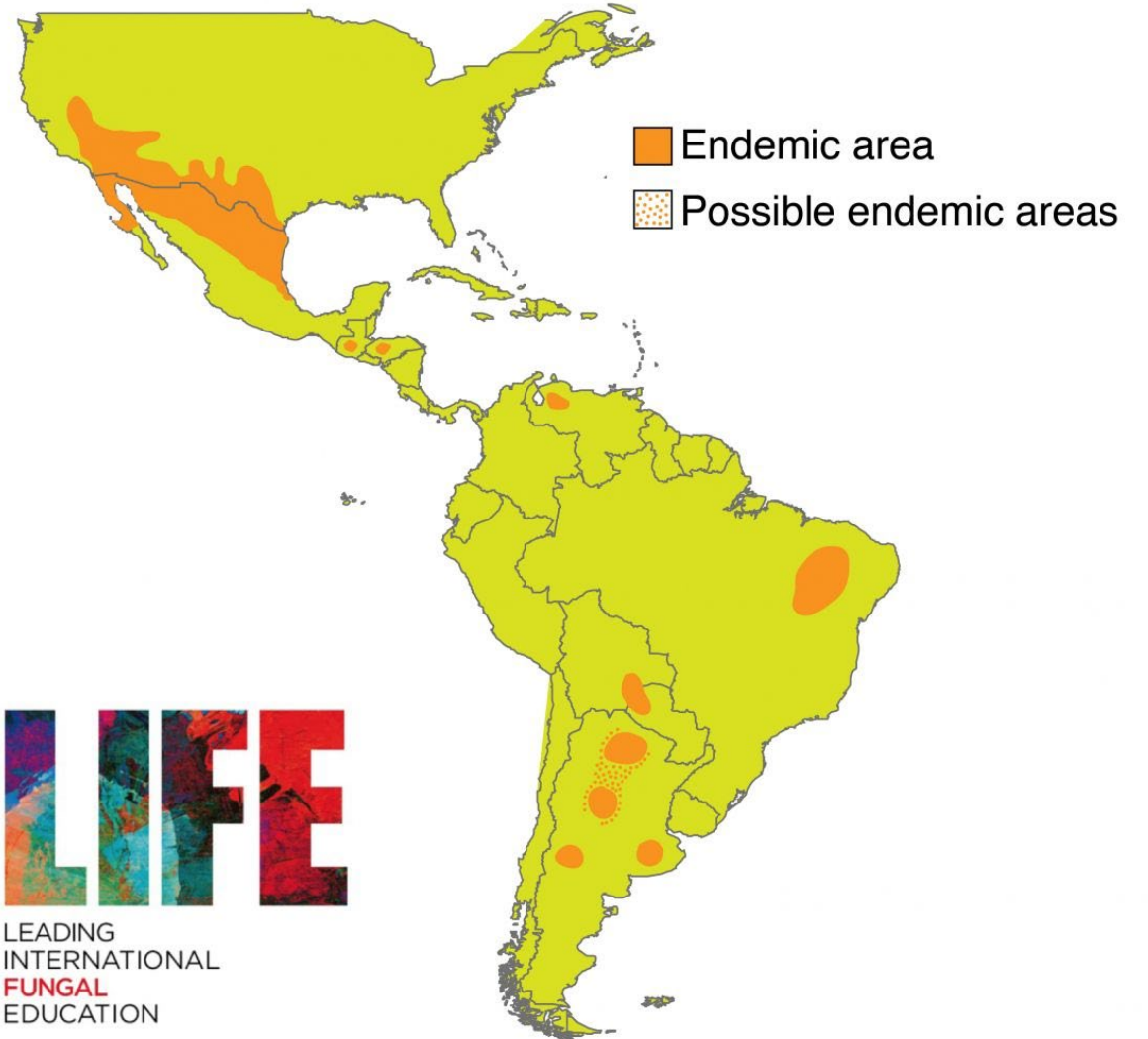


Desmodus rotundus

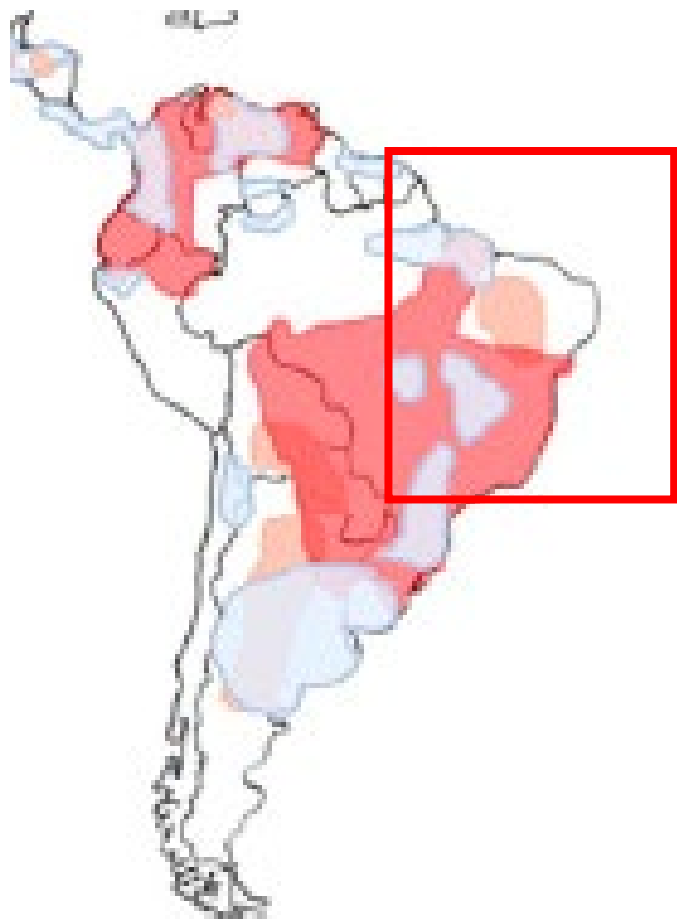
Coccidioidomycosis



Coccidioidomycosis

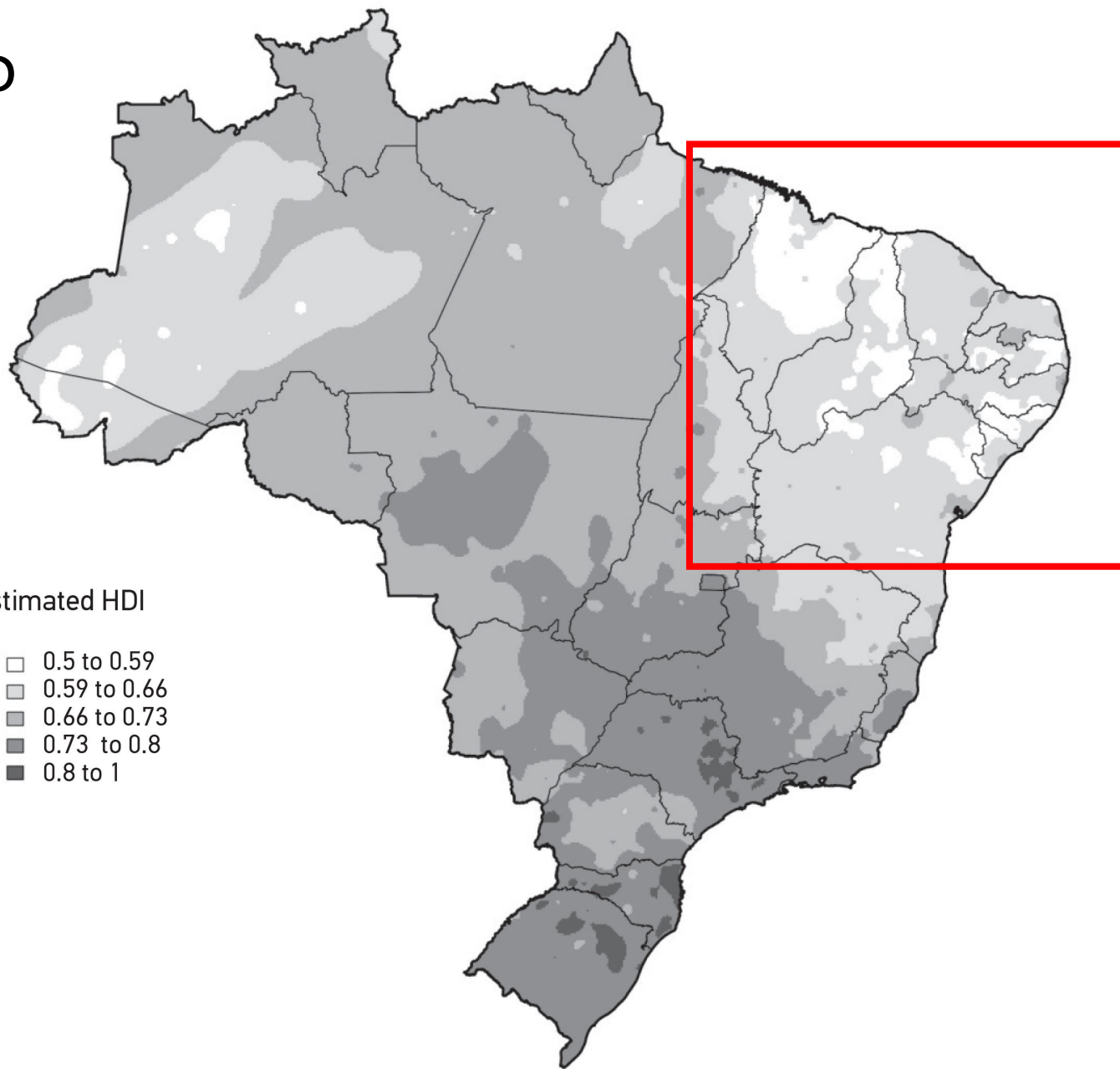


Why Northeast Brazil?

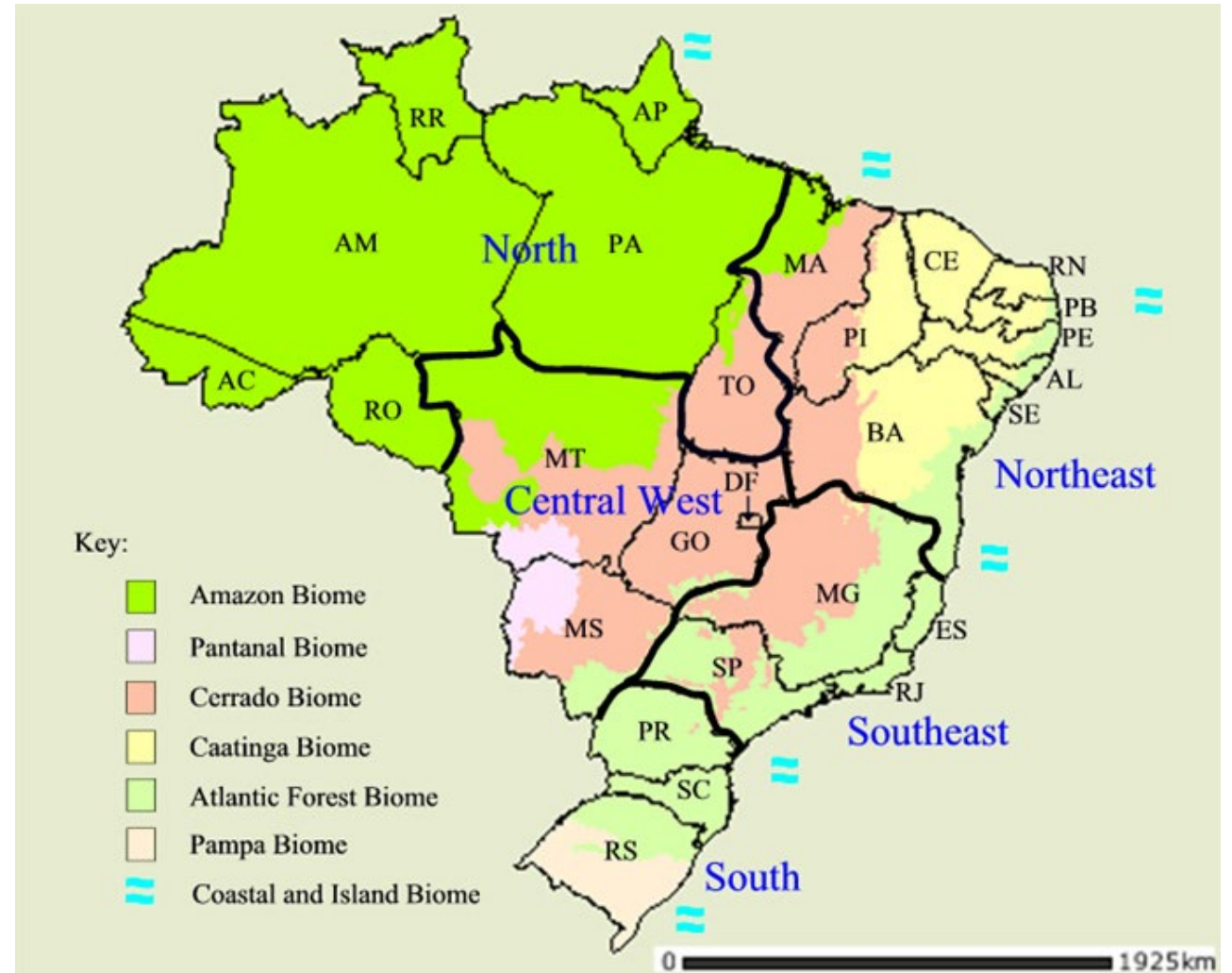
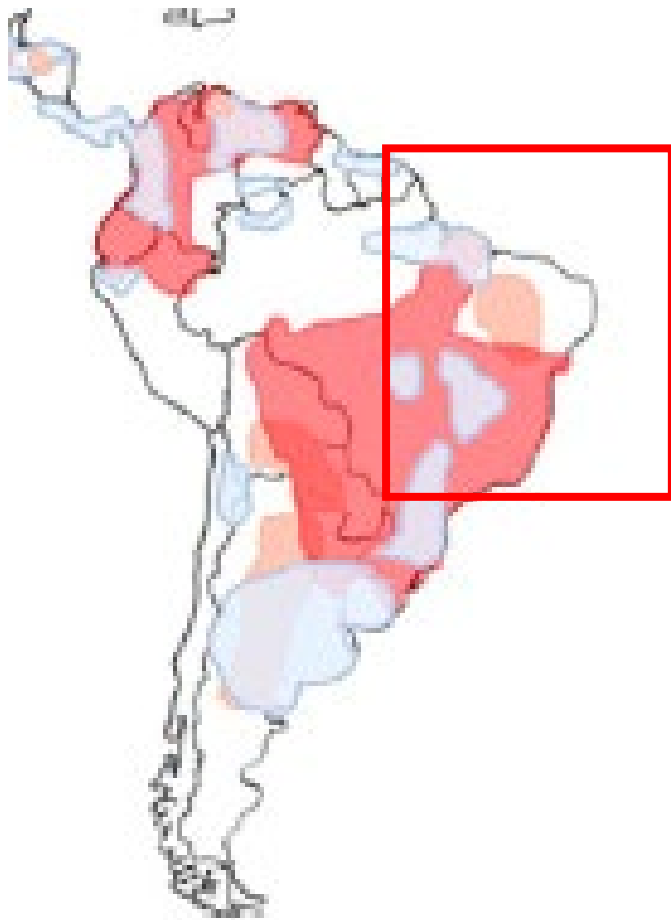


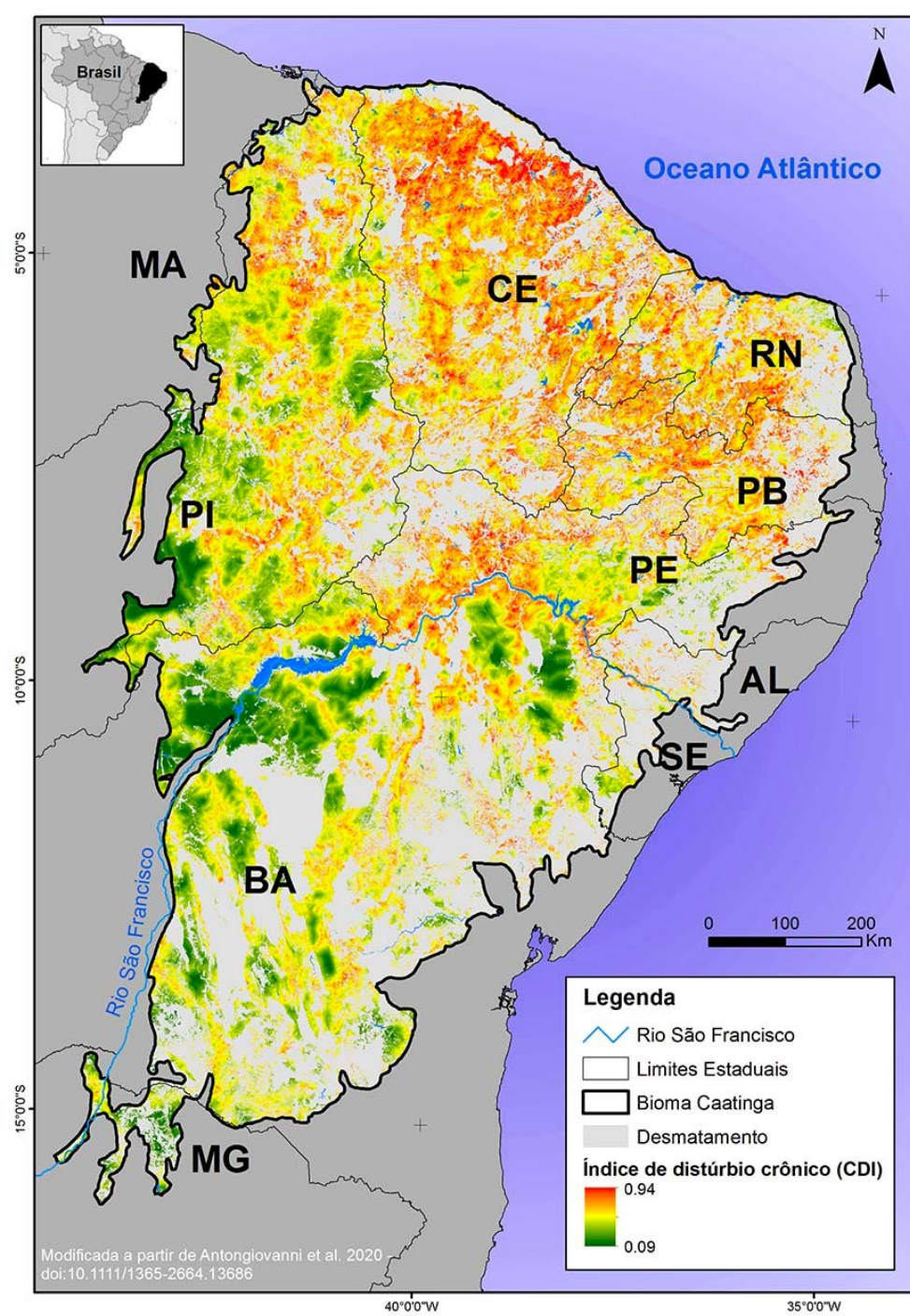
Estimated HDI

- 0.5 to 0.59
- 0.59 to 0.66
- 0.66 to 0.73
- 0.73 to 0.8
- 0.8 to 1



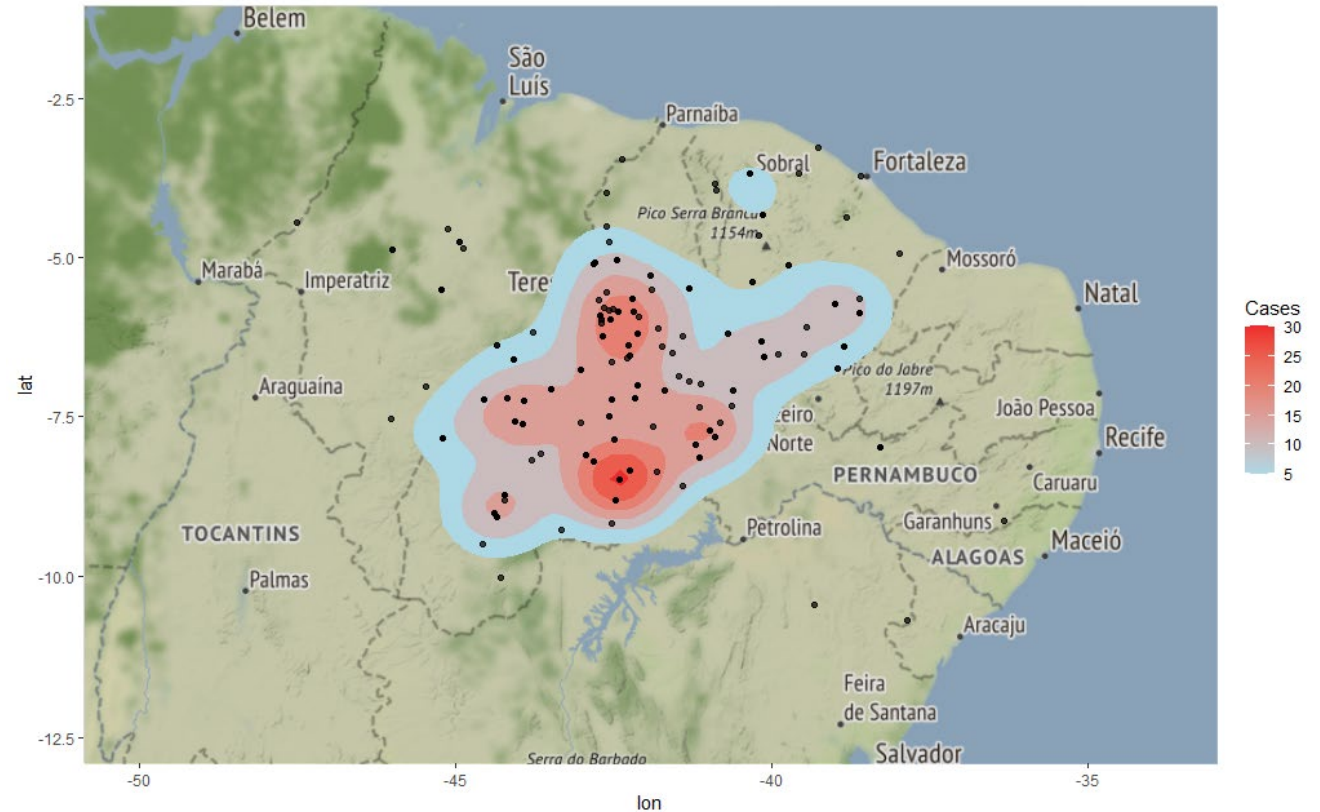
Why Northeast Brazil?



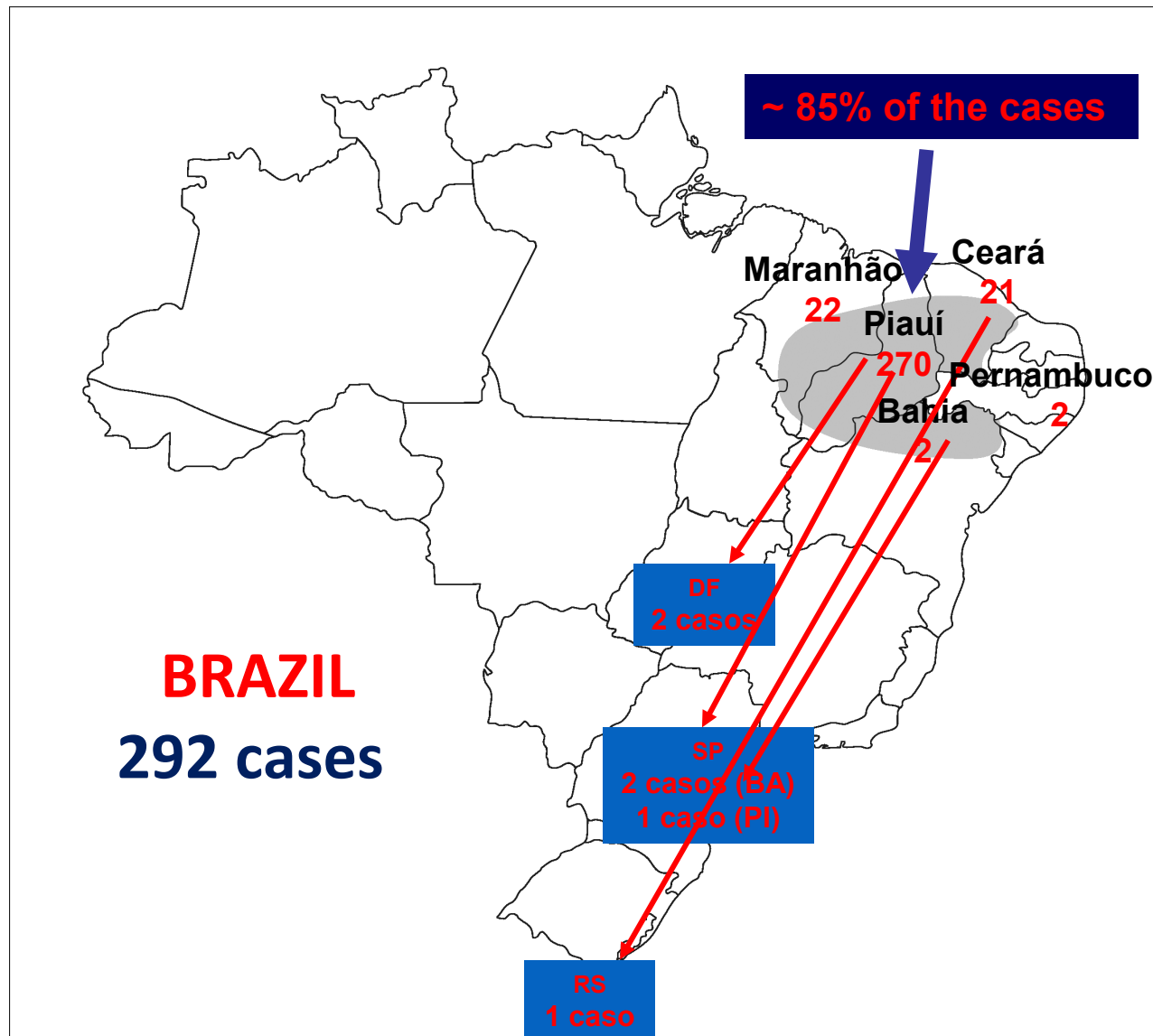


Coccidioidomycosis in Brazil

- Largest case-series outside the hyperendemic area in North America (USA/MX);
- 292 cases (1978 - 2021);
- Maranhão (22) and Piauí (270);
- Males (98%) over females (2%);
- Mean age: 31 (7-82);
- Ethnicity:
 - Black - 78.4%
 - White – 20.9%
 - Indians – 0.7%



Coccidioidomycosis in Brazil; (2023) : PI, CE, MA, BA e PE





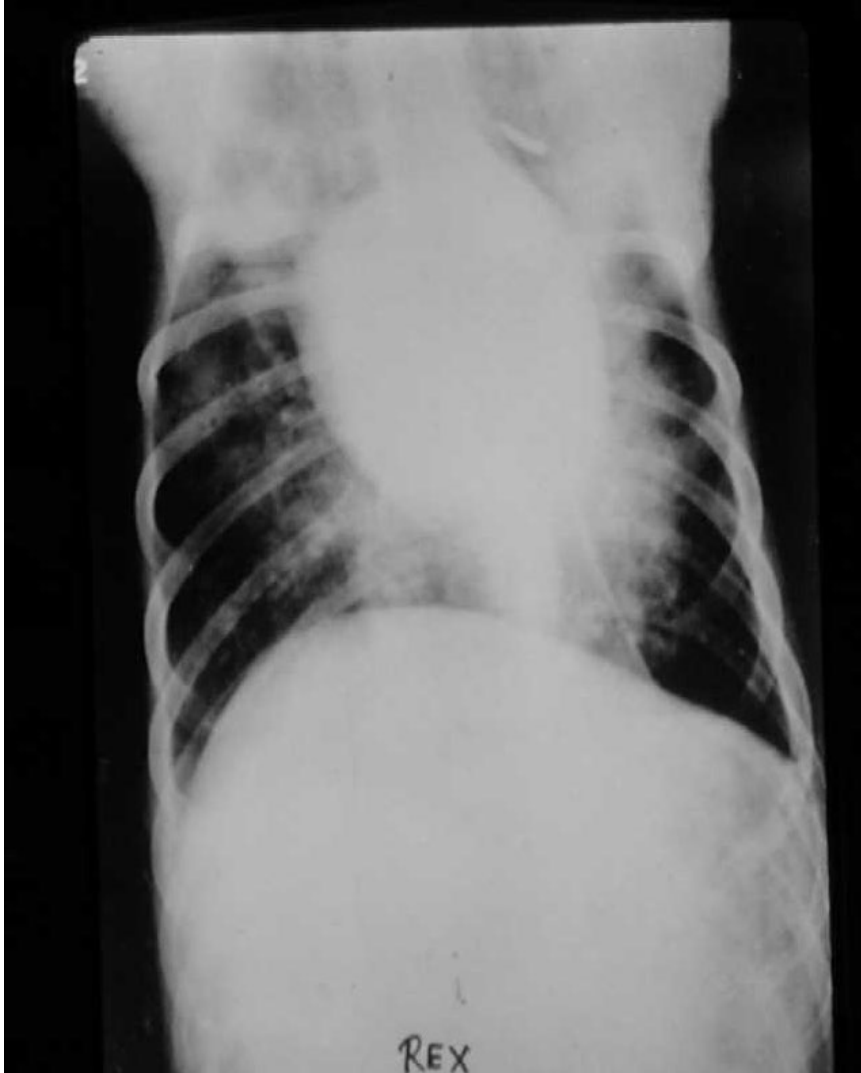
Risk Factors		N/%	
Armadillo Hunting		266	91,1
Manioc harvest		10	3,4
Pond excavation		3	1,1
Rock extraction		2	0,7
Gardening		2	0,7
Soil preparation		2	0,7
Fence		1	0,3
Charcoal		1	0,3
Fômites		1	0,3
NI		4	1,4
CLINICAL FORM			
Acute pulmonary		271	92,8
Disseminated		10	3,4
Chronic		7	2,4
Regressive		04	1,4



Risk factors



Canine coccidioidomycosis in Brazil

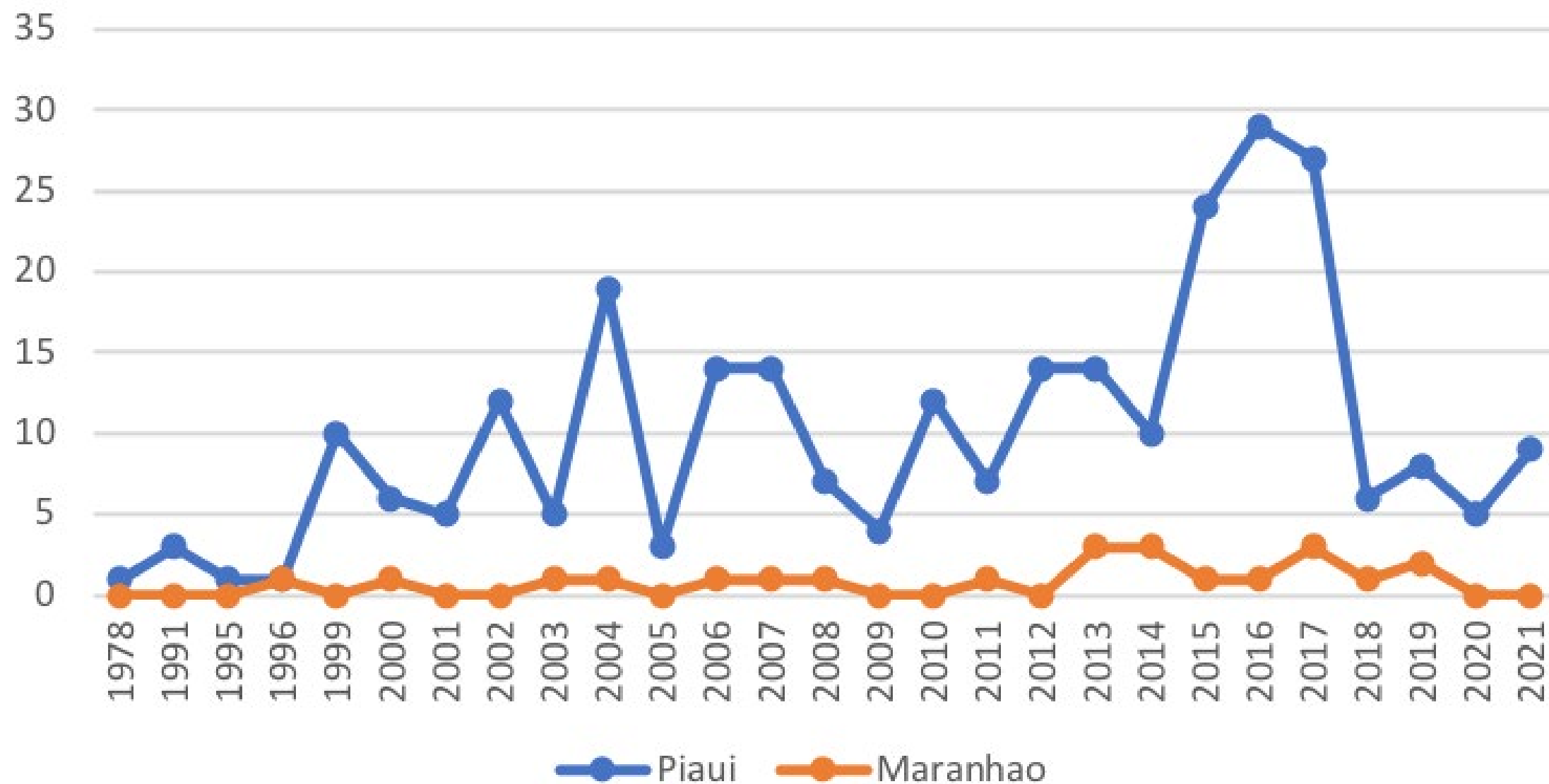


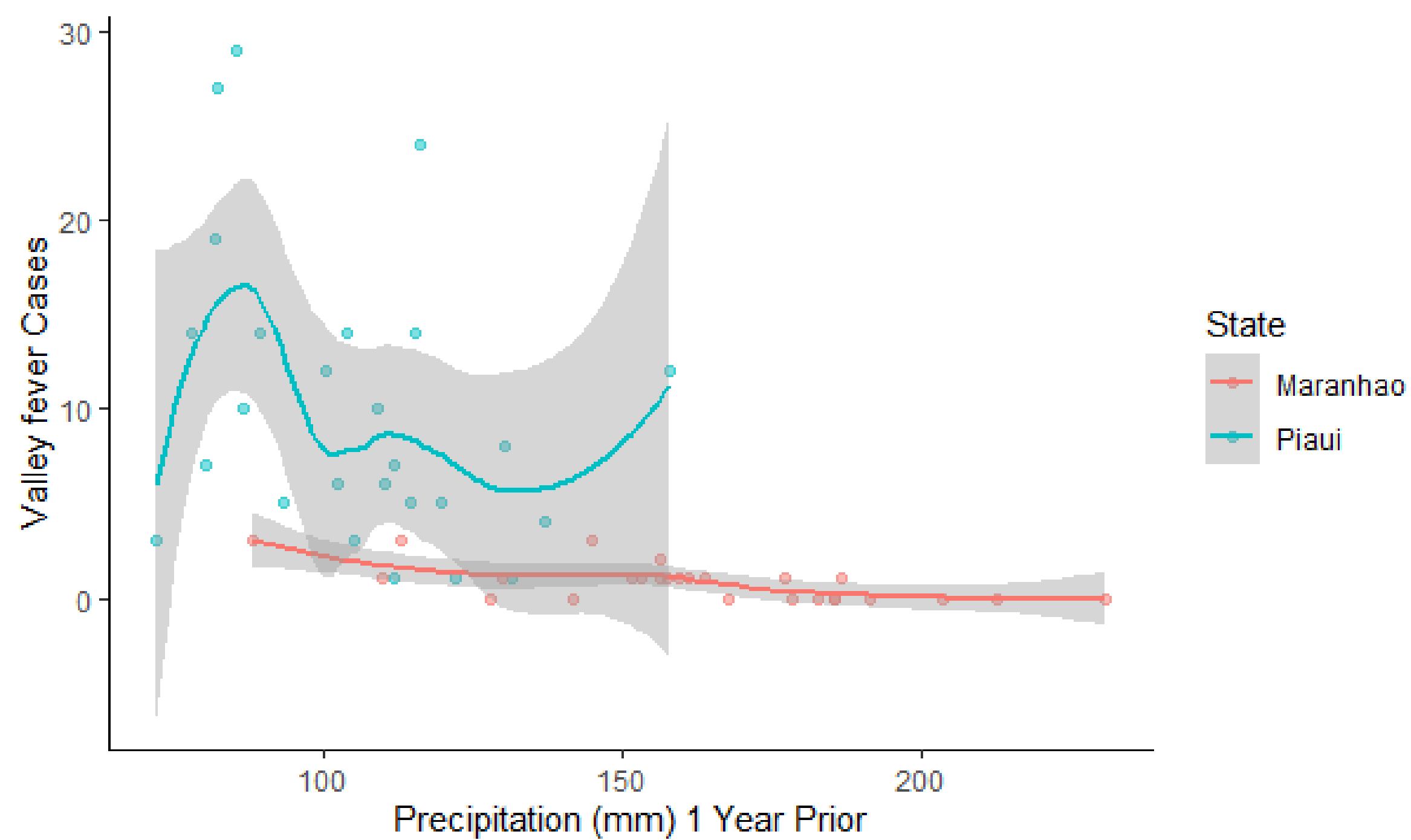
Coccidioidomycosis in Brazil – Clinical aspects

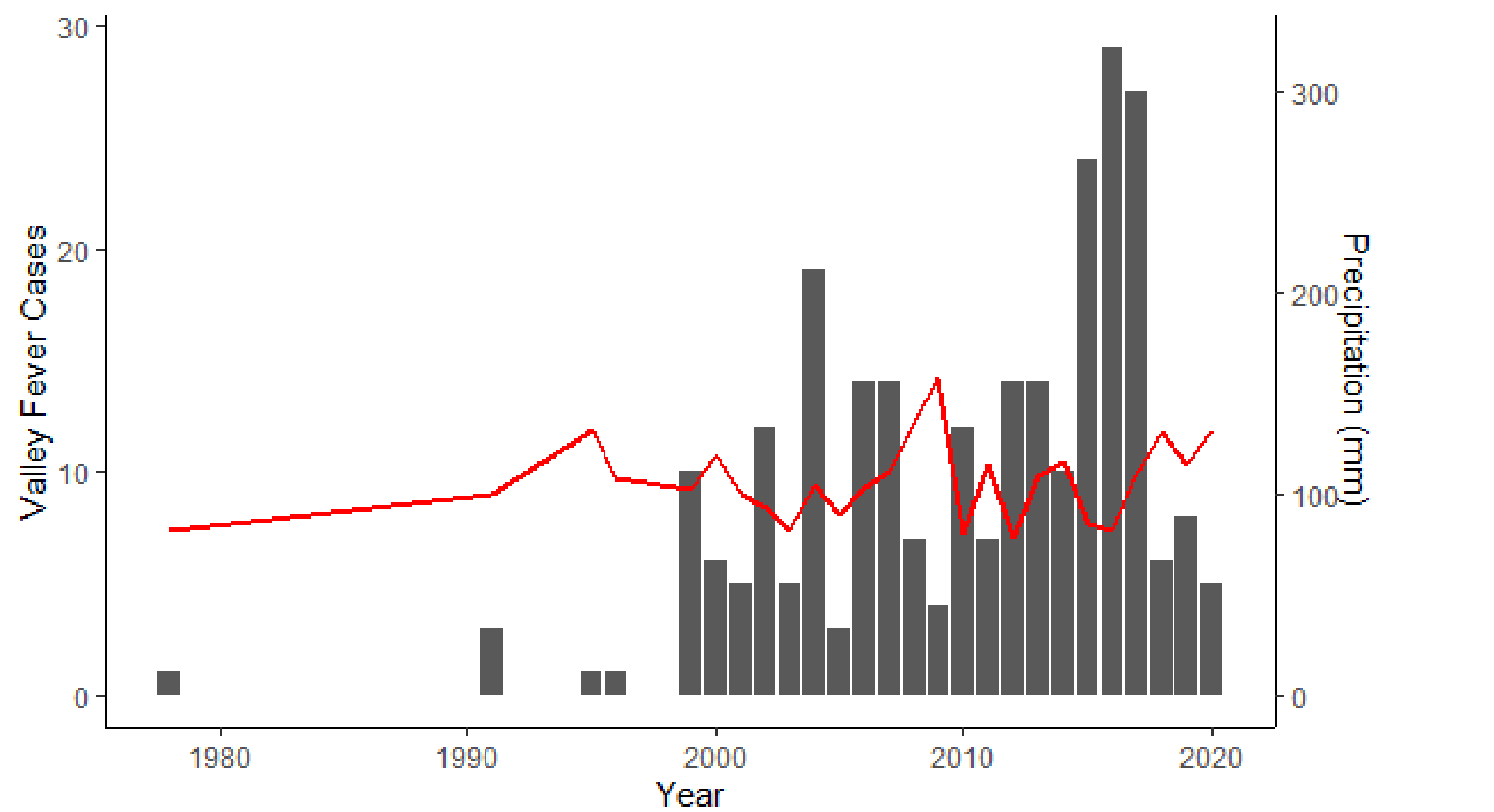
- Pulmonary – 100%
- 42 microepidemics - >2 people
- Cough, fever and thoracic pain
- Acute pulmonary infection – 21 days for resolution
- Incubation 10 days (mean 4 to 30 days)
- No HIV
- Coinfection with Tb
- Infrequent cutaneous hypersensitivity symptoms
- Dissemination (5-10%)
- Resolution – 90%
- Deaths due to pulmonary complications or CNS

Clinical symptoms	Patients (%)
Cough	93
Fever	90
Thoracic pain	77
Adynamia	59
Anorexia	53
Dyspnea	51
Headache	37
Weight loss	33
Myalgia	31
Arthralgia	28
Erythema nodosum	10
Polymorphic erythema	8
Abdominal pain	7
Cutaneous rash	6
Oral lesions	4
Vomiting	4
Hemoptysis	4
Skin nodules	3
Mental confusion	2
Convulsion	2
Lymphadenopathy	2
Arthritis	1

Coccidioidomycosis in Brazil

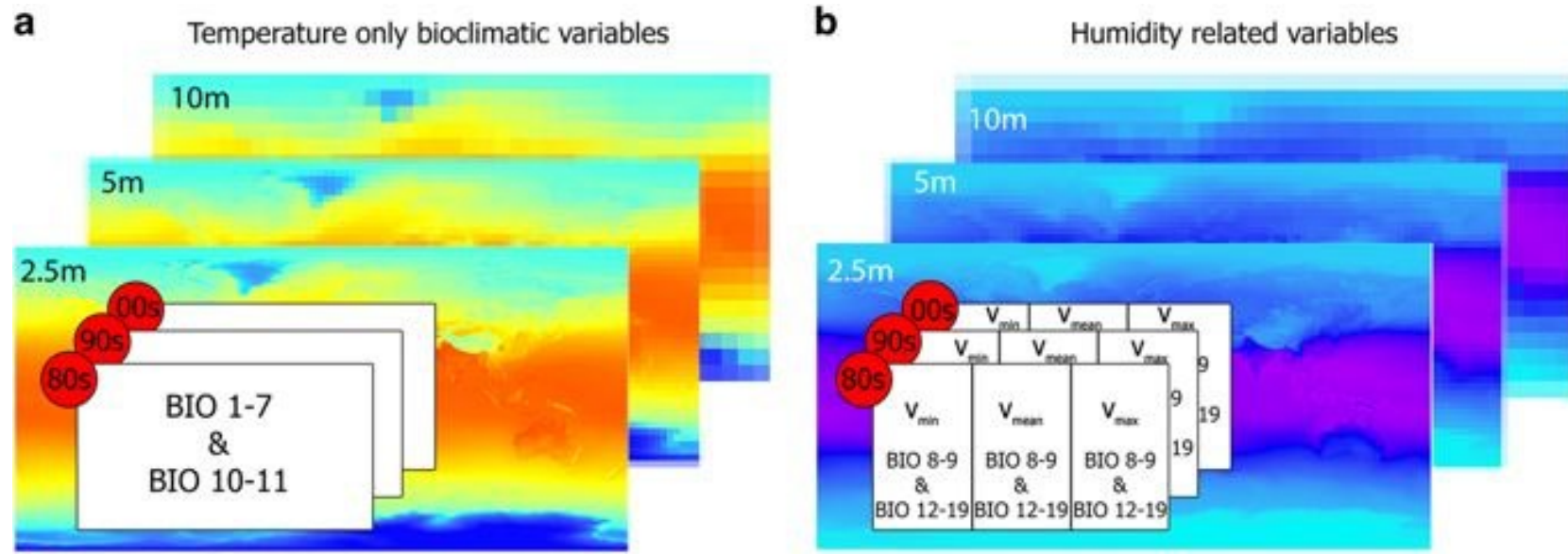




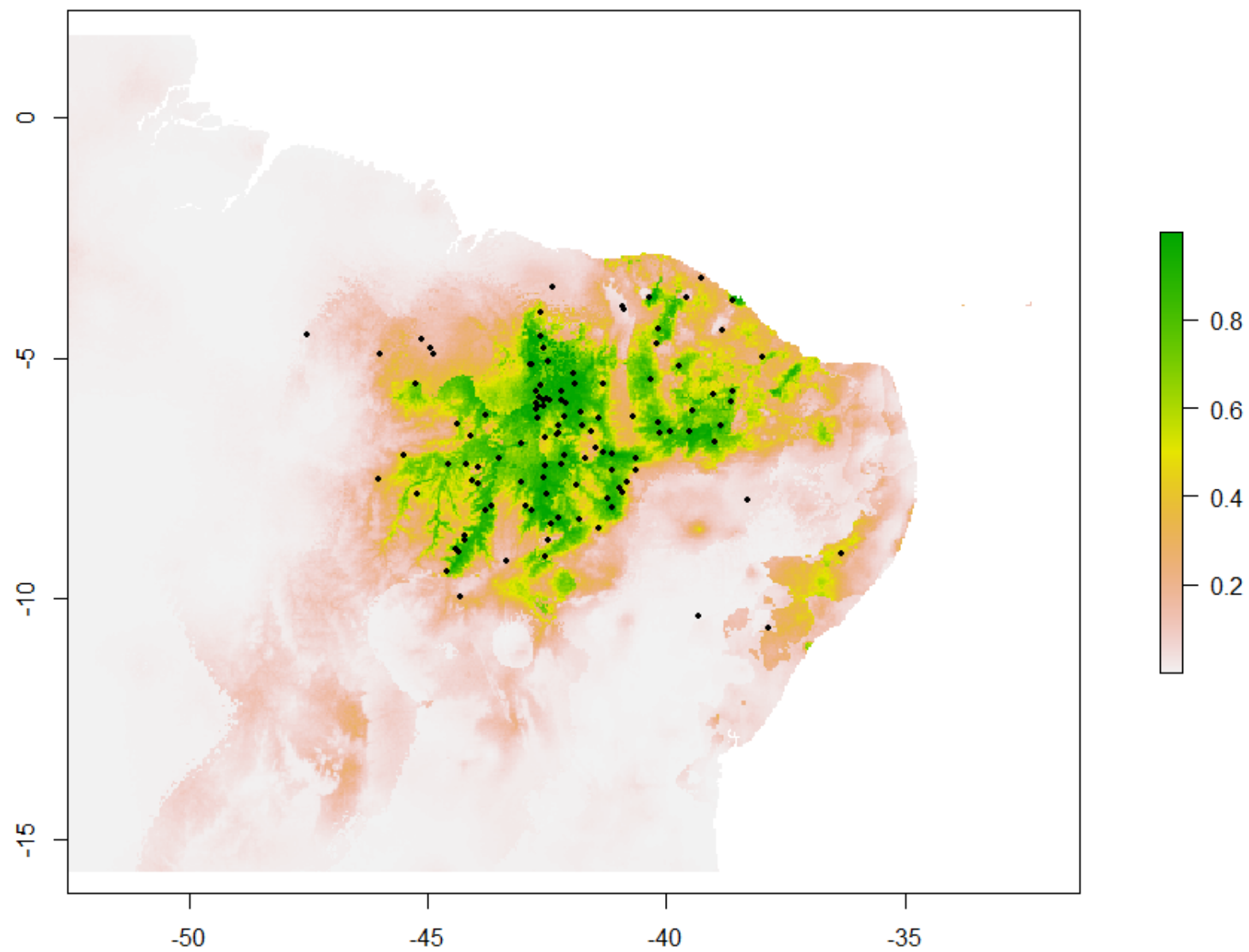


Species modeling for delimitate the rang of *Coccidioides sp.* in Northeast Brazil

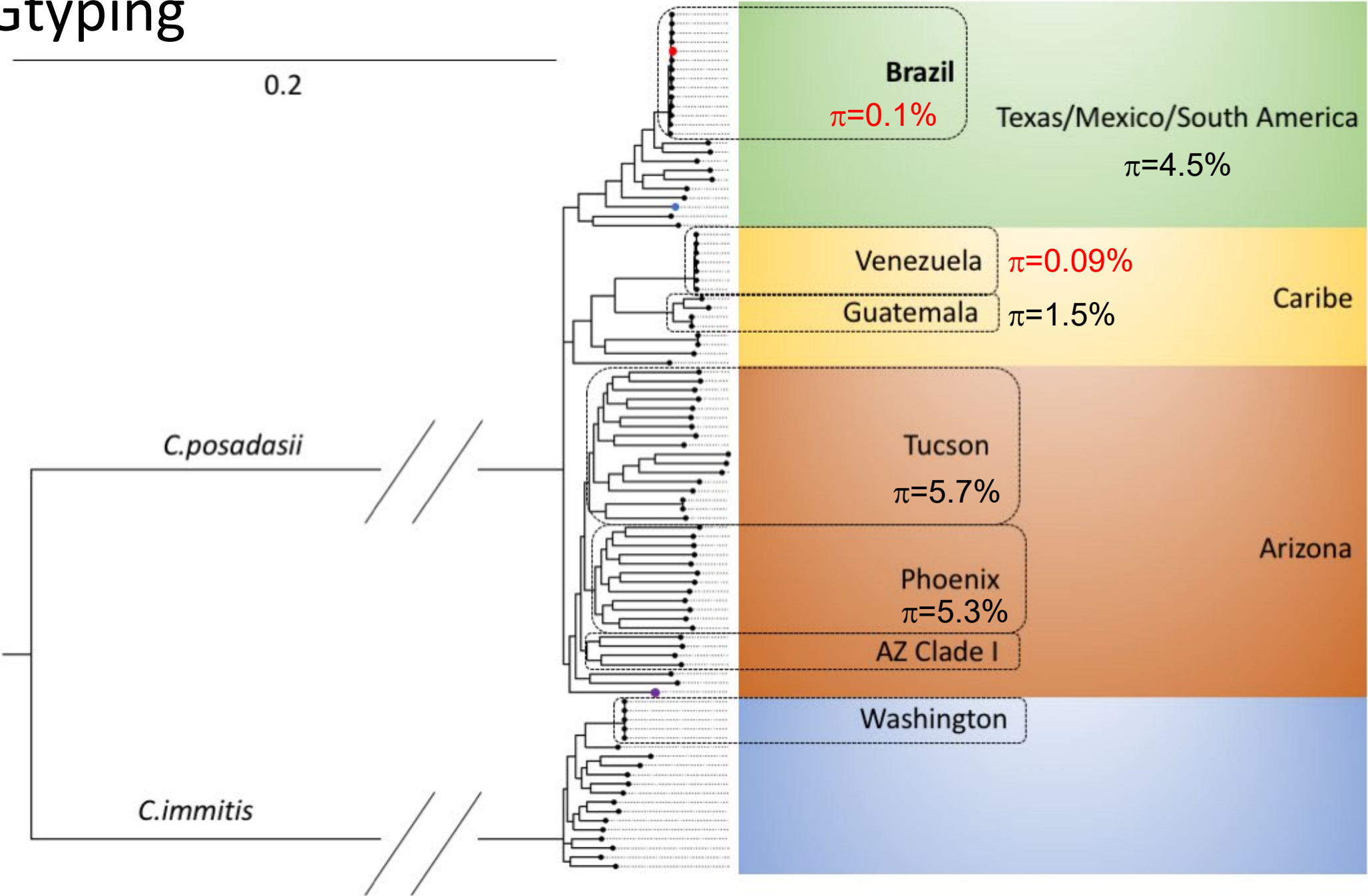
- Environmental data;
- Clinical data;



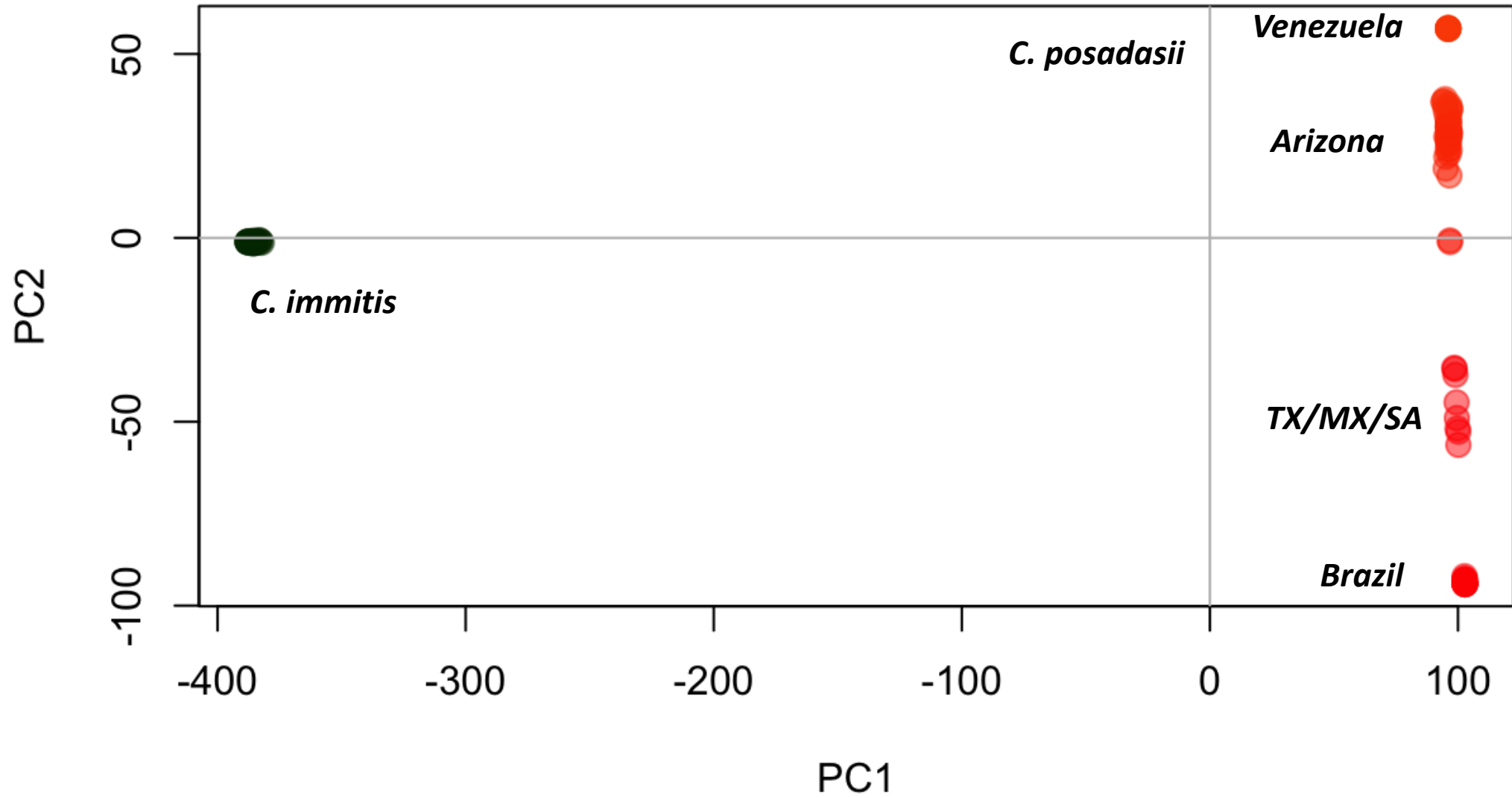
Predicited Realized Niche of *Coccidioides* spp in Brazil



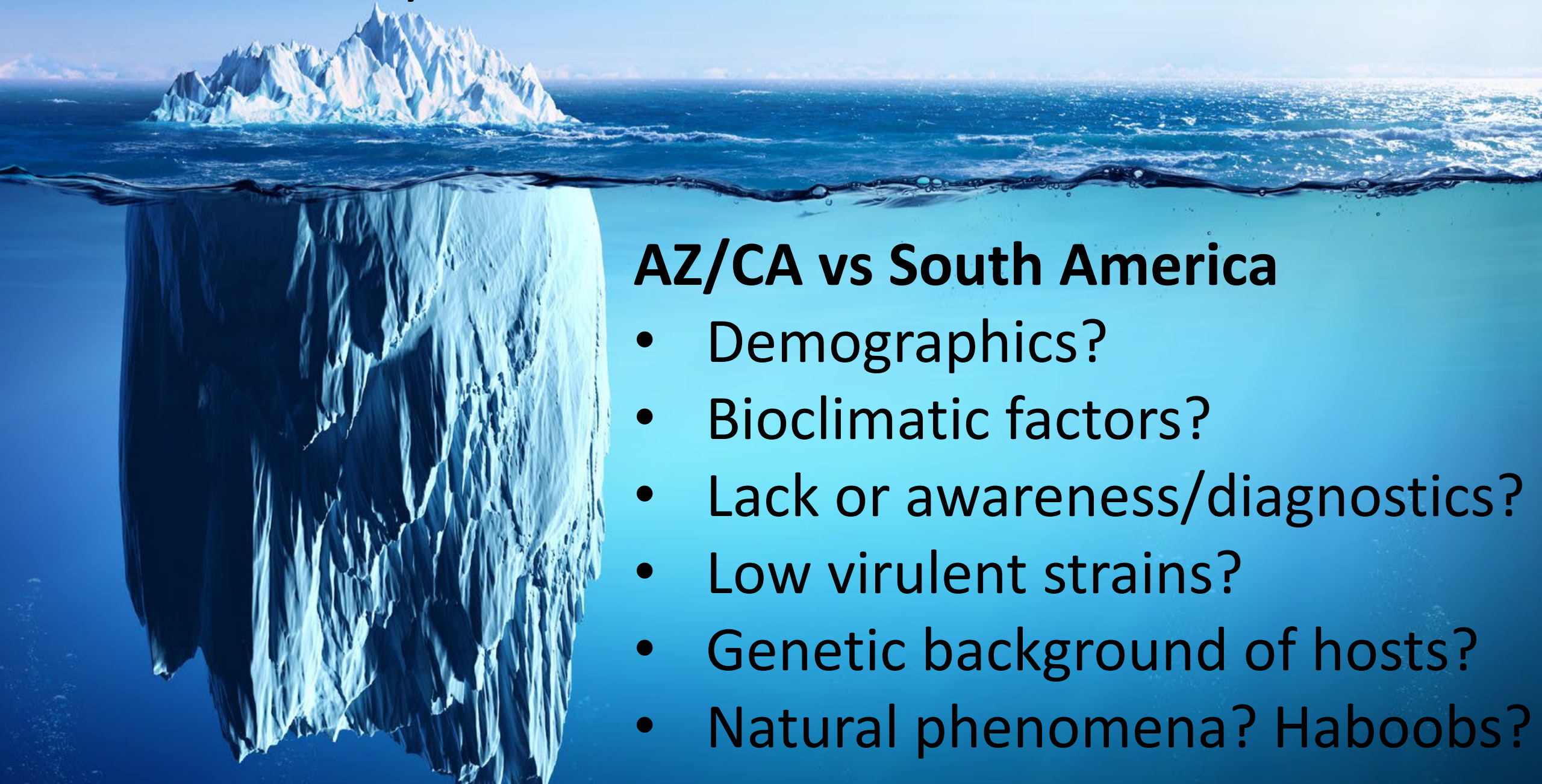
WGtyping



PCA



Coccidioidomycosis in Brazil



AZ/CA vs South America

- Demographics?
- Bioclimatic factors?
- Lack of awareness/diagnostics?
- Low virulent strains?
- Genetic background of hosts?
- Natural phenomena? Haboobs?

Fungi can cause Community Acquired Pneumonia!!!

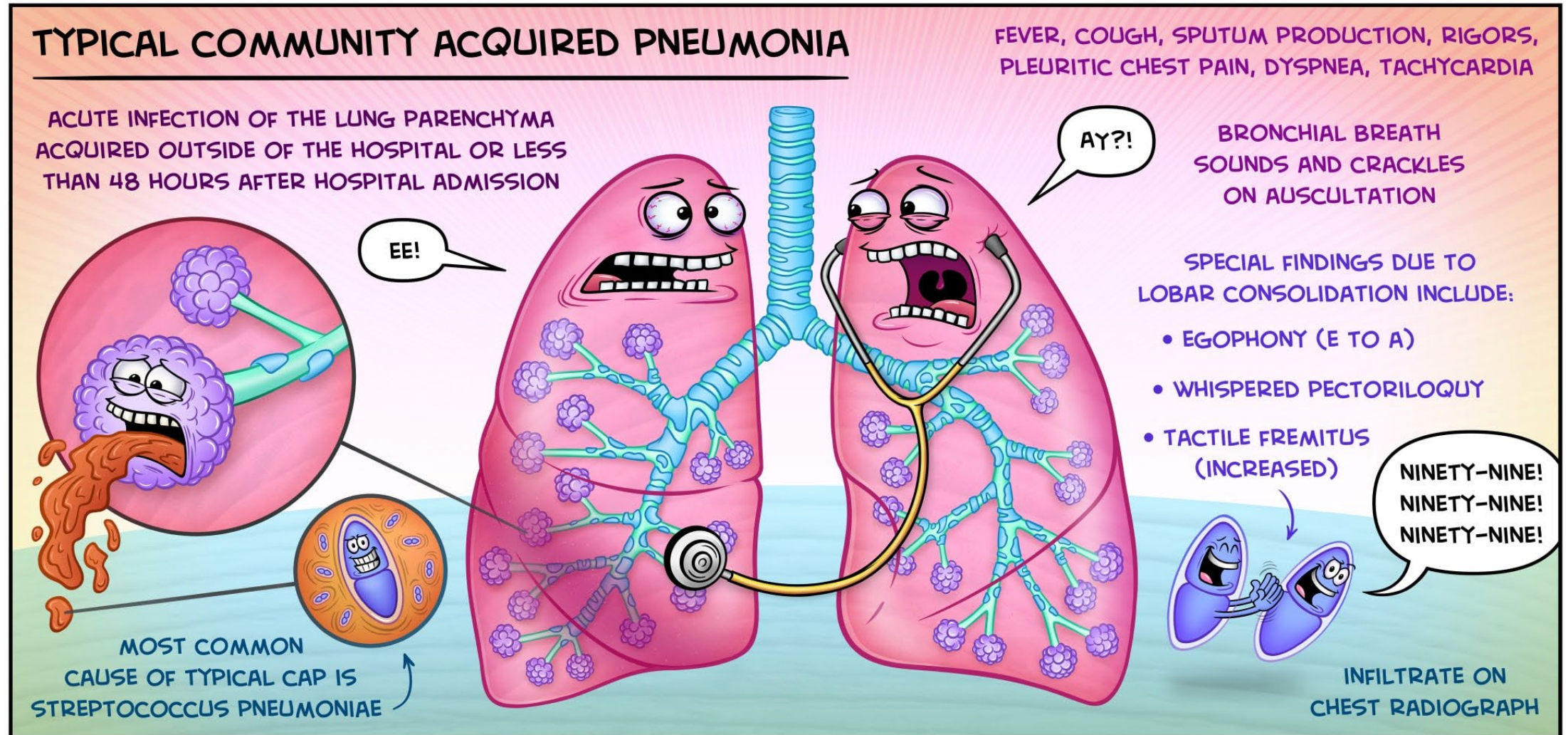
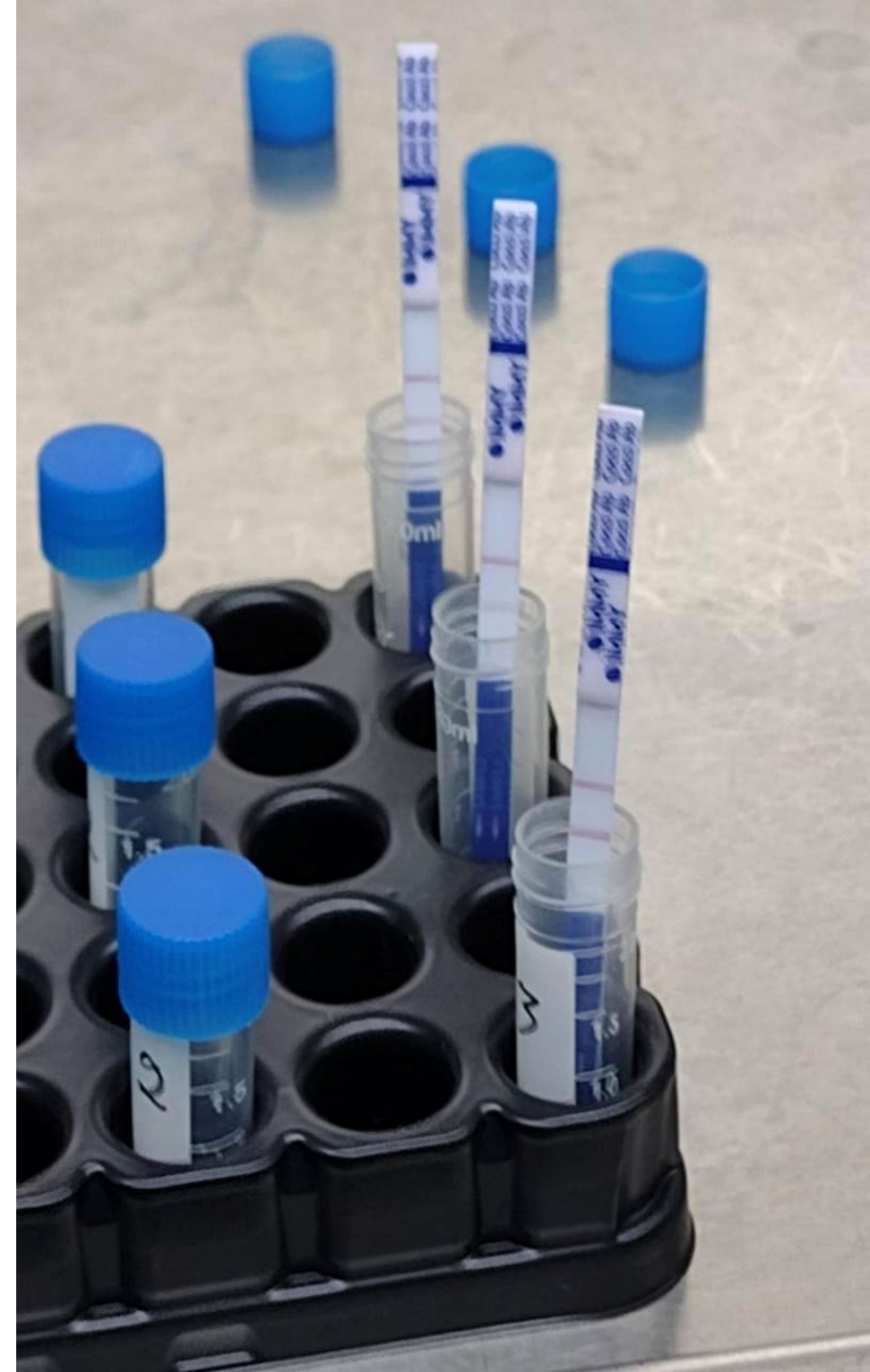
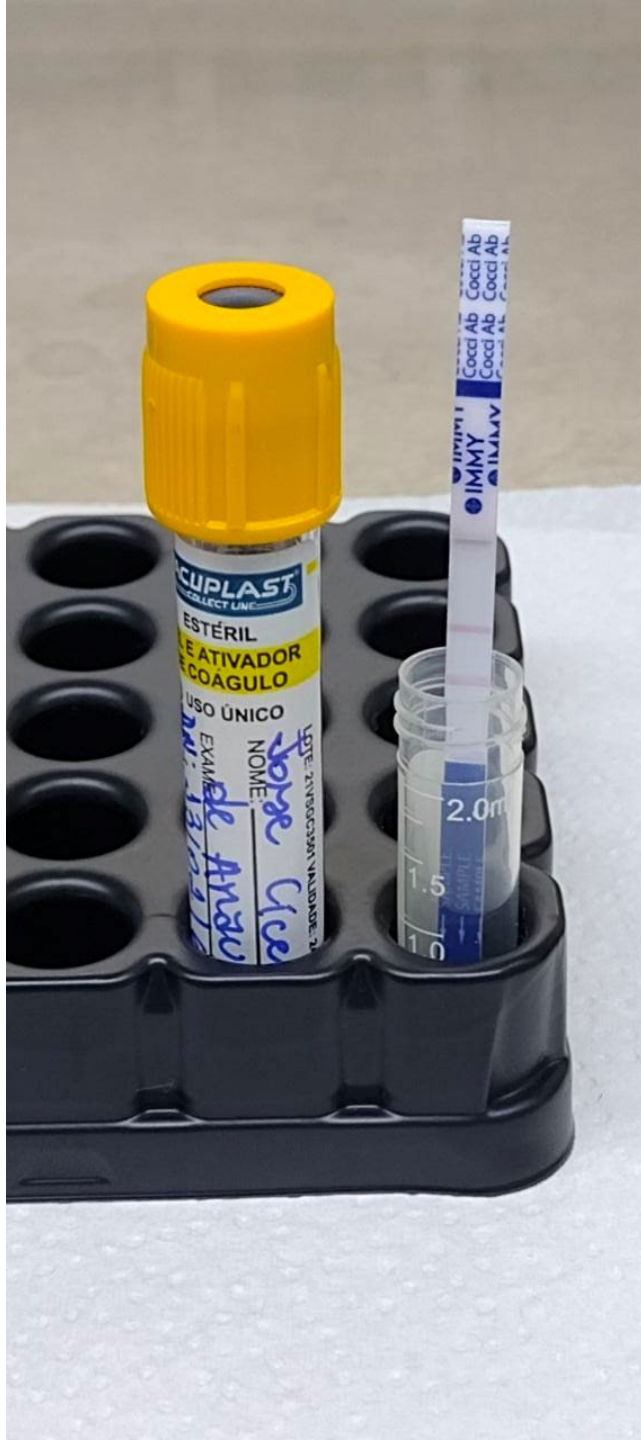


Table 1. Risk Factors and Pathogens in Community-Acquired Pneumonia

<i>Risk factor</i>	<i>Related pathogens</i>
Alcoholism	Anaerobic oral flora, <i>Klebsiella pneumoniae</i> , <i>Mycobacterium tuberculosis</i> , <i>Streptococcus pneumoniae</i>
Aspiration	Anaerobic oral flora
Bioterrorism	<i>Bacillus anthracis</i> (anthrax), <i>Francisella tularensis</i> (tularemia), <i>Yersinia pestis</i> (plague)
Chronic obstructive pulmonary disease or smoking	<i>Chlamydophila pneumoniae</i> , <i>Haemophilus influenzae</i> , <i>Legionella</i> species, ^{9,10} <i>Moraxella catarrhalis</i> , <i>Pseudomonas aeruginosa</i> or other gram-negative rods, <i>S. pneumoniae</i>
Exposure to bat or bird droppings	<i>Histoplasma capsulatum</i>
Exposure to farm animals or parturient cats	<i>Coxiella burnetii</i> (Q fever)
HIV infection (early)	<i>H. influenzae</i> , <i>M. tuberculosis</i> , <i>S. pneumoniae</i>
HIV infection (late)	<i>Aspergillus</i> and <i>Cryptococcus</i> species, <i>H. capsulatum</i> , <i>H. influenzae</i> , <i>Nocardia</i> species, nontuberculous mycobacteria, <i>Pneumocystis jiroveci</i>
Hotel or cruise ship travel in past two weeks	<i>Legionella</i> species
Influenza active in community	<i>H. influenzae</i> , influenza and other respiratory viruses, <i>S. pneumoniae</i> , <i>Staphylococcus aureus</i> (including MRSA)
Injection drug use	Anaerobes, <i>M. tuberculosis</i> , <i>S. aureus</i> (including MRSA), <i>S. pneumoniae</i>
Lung abscess	Anaerobic oral flora, <i>M. tuberculosis</i> , nontuberculous mycobacteria, <i>S. aureus</i> (including MRSA)
Travel to or residence in Middle East	Middle East respiratory syndrome
Travel to or residence in Southeast Asia and East Asia	Avian influenza, severe acute respiratory syndrome
Travel to or residence in southeastern and south-central states bordering the Mississippi and Ohio River basins	<i>Blastomyces dermatitidis</i>
Travel to or residence in southwestern United States	<i>Coccidioides</i> species, <i>Hantavirus</i> species

HIV = human immunodeficiency virus; MRSA = methicillin-resistant *Staphylococcus aureus*.

Adapted with permission from Mandell LA, Wunderink RG, Anzueto A, et al. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. Clin Infect Dis. 2007;44(suppl 2):S46, with additional information from references 9 through 11.



Dr. Bodo Wanke



Collaborators

- **UnB**

Marcus de Melo Teixeira

Joaquin Lucas

Herdson Souza

André Nicola

Lucas Gomes Brito

João Eudes

- **UNESP Botucatu**

Eduardo Bagagli

Danielle Yamaguchi

Hanh Garcia

- **INI/FIOCRUZ**

Bodo Wanke

Rosely Zancope

Rodrigo Paes

Fernando Almeida

Lucas Machado Moreira

- **PMI/NAU - USA**

Bridget Barker

Daniel Kolath

- **UFPI**

Kelsen Eulálio

Amparo Salmito

Liline Martins

Raissa Escorcio

Fabiano Silva

Herion Alves

- **UFC**

Rossana Cordeiro

Santiago Moura

Terezinha Menino

Lisandra Serra

- **UCB-DF**

Maria Sueli Felipe

- **UFT Araguaina**

Antônio Oliveira

Alessandra Krackeke

Thank you!

