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Epidemiology of implantation mycoses in the United States: An analysis of commercial insurance claims data, 2017 to 2021

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To the Editor: Implantation mycoses, such as eumycetoma, chromoblastomycosis (including phaeohyphomycotic abscesses), and other deep mycoses (eg, sporotrichosis, mucormycosis), constitute a diverse group of fungal neglected tropical diseases that usually develop after traumatic skin inoculation.[1–3] Although dermatologists frequently learn about these uncommon conditions during training, clinical exposure may be limited outside tropical regions. Baseline epidemiologic data on implantation mycoses might improve clinical recognition and are needed given the potential for climate change-related expansion of geographic range.[3] Therefore, we estimated prevalence and described features of US patients diagnosed with implantation mycoses during January 1, 2017 to December 31, 2021.

We analyzed the Merative MarketScan Commercial and Medicare Supplemental databases, using International Classification of Diseases, 10th Revision codes to identify implantation mycosis patients and their underlying conditions (Supplementary Material, available via Mendeley at https://data.mendeley.com/datasets/6h34zp6mdr10.17632/6h34zp6mdr.1). For each mycosis, we estimated 5-year prevalence, stratifying by demographic features. Using a nested case-control study design, we performed logistic regressions to evaluate associations between each mycosis and underlying conditions, adjusting for age, sex, and region.

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This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy (eg, 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq).

Conflicts of interest

Dr Lipner has served as a consultant for BelleTorus Corporation, Hoth Therapeutics, Moberg Pharmaceuticals, and Ortho-dermatologics. Dr Gold, Author Smith, Author Benedict, and Dr Lockhart have no conflicts of interest to declare.

During 2017 to 2021, among ~45,000,000 unique patients, each implantation mycosis was diagnosed in <15 per 1,000,000 (Table I). Prevalence per 1,000,000 was highest for chromoblastomycosis (14.7), followed by sporotrichosis (12.4), mucormycosis (10.4), and eumycetoma (5.2). Across mycoses, prevalence generally increased with age and was highest among patients aged ≥65 years. Prevalence was higher among females versus males for sporotrichosis (13.1 vs 11.6) and eumycetoma (6.4 vs 4.0). Prevalence varied by region, with chromoblastomycosis highest in the Northeast (16.4), sporotrichosis highest in the South (14.7), mucormycosis highest in the West (11.9), and eumycetoma highest in the Midwest (5.8). Prevalence was higher in rural versus nonrural areas, except for eumycetoma (2.9 vs 5.5).

In case-control analyses, immunosuppression was significantly associated with each implantation mycosis. Mucormycosis had the highest odds of diabetes (adjusted odds ratio: 3.63, 95% CI: 2.81–4.68), hypertension (2.78, 2.15–3.59), and immuno-compromising conditions (12.31, 10.06–15.08) (Table II). Mucormycosis was more often initially diagnosed in inpatient settings (41.0%) than the other mycoses (range: 3.8%–5.4%).

Our analysis provides insight into US epidemiology and factors associated with implantation mycoses. Chromoblastomycosis was more prevalent than mucormycosis and sporotrichosis, 2 conditions that are more widely recognized and studied in the United States. This finding might reflect the comparatively indolent course of chromoblastomycosis,[1] but also highlights the need for increased clinical attention. The higher prevalence of sporotrichosis in the South and mucormycosis in the West and high percentage of mucormycosis-associated hospitalizations are consistent with previous studies.[4,5] The female predominance for eumycetoma contrasts with international settings, where eumycetoma primarily affects male outdoor field-workers, potentially reflecting different care-seeking behaviors or exposures.[2]

Limitations include the data set's lack of information on race/ethnicity, laboratory testing results (thus, reliance on International Classification of Diseases, 10th Revision codes), exposure characteristics (eg, travel, immigration history), and patients without commercial insurance.

We highlight an association between implantation mycoses and immunosuppressive conditions, which might increase susceptibility or allow progression of latent disease. Because these infections are rare, our findings underscore the need for clinical vigilance, treatment guidelines, surveillance, and improved diagnostic tools, given the potential for debilitating disease if untreated.

REFERENCES

1. Queiroz-Telles F, Nucci M, Colombo AL, Tobón [notdef] A, Restrepo A. Mycoses of implantation in Latin America: an overview of epidemiology, clinical manifestations, diagnosis and treatment. Med Mycol. 2011;49:225–236. [PubMed: 21128710]
2. Emery D, Denning DW. The global distribution of actinomycetoma and eumycetoma. PLoS Negl Trop Dis. 2020;14: e0008397.

3. Gadre A, Enbiale W, Andersen LK, Coates SJ. The effects of climate change on fungal diseases with cutaneous manifestations: a report from the International Society of Dermatology Climate Change Committee. J Clim Change Health. 2022;6: 100156.

4. Benedict K, Jackson BR. Sporotrichosis cases in commercial insurance data, United States, 2012–2018. Emerg Infect Dis. 2020;26:2783–2785. [PubMed: 33079045]

5. Vallabhaneni S, Benedict K, Derado G, Mody RK. Trends in hospitalizations related to invasive aspergillosis and mucormycosis in the United States, 2000–2013. Open Forum Infect Dis. 2017;4:ofw268. 10.1016/j.jaad.2023.04.048 [PubMed: 28480260]

Table I.

Five-y prevalence (per 1,000,000 patients) of fungal neglected tropical diseases affecting the skin in a large, commercially insured population—United States, 2017 to 2021 *

	Chromoblastomycosis and phaeohyphomycotic abscess (*n* = 667)	Sporotrichosis (*n* = 562)	Mucormycosis (*n* = 474)	Eumycetoma (*n* = 238)
All	667 (14.7)	562 (12.4)	474 (10.4)	238 (5.2)
Age group, y				
<18	107 (10.2)	25 (2.4)	42 (4.0)	7 (0.7)
18–34	120 (9.8)	45 (3.7)	84 (6.8)	37 (3.0)
35–44	96 (14.0)	78 (11.4)	67 (9.8)	40 (5.8)
45–54	119 (16.9)	133 (18.9)	81 (11.5)	47 (6.7)
55–64	158 (24.4)	206 (31.9)	142 (22.0)	73 (11.3)
≥65	67 (30.1)	75 (33.7)	58 (26.0)	34 (15.3)
Sex				
Male	348 (16.4)	247 (11.6)	257 (12.1)	84 (4.0)
Female	319 (13.2)	315 (13.1)	217 (9.0)	154 (6.4)
Census region				
Northeast	134 (17.1)	70 (8.9)	84 (10.7)	38 (4.9)
Midwest	117 (12.7)	125 (13.5)	79 (8.5)	54 (5.8)
South	335 (16.4)	299 (14.7)	215 (10.6)	111 (5.4)
West	78 (10.0)	66 (8.5)	93 (11.9)	34 (4.4)
Unknown	3	2	3	1
Urban-rural residence				
Nonrural	582 (14.4)	486 (12.0)	414 (10.3)	223 (5.5)
Rural	83 (16.9)	74 (15.1)	59 (12.0)	14 (2.9)
Unknown	2	2	1	1

* Data are shown as no. (5-year prevalence per 1 million patients). Rhinosporidiosis, talaromycosis, and lobomycosis diagnoses were also examined, but because they were very uncommon (each diagnosed in <100 patients during the study period), these conditions were excluded from the analysis. Individual patients could have diagnosis codes for >1 mycosis (eg, sporotrichosis and mucormycosis); this occurred for <0.5% of patients. Individual patients could also have diagnosis codes for >1 subcategory of mycosis (eg, pulmonary mucormycosis and cerebral mucormycosis). For chromoblastomycosis and phaeohyphomycotic abscess, 64% had an International Classification of Diseases, 10th Revision (ICD-10) code for subcutaneous phaeohyphomycotic abscess and cyst, 13% for cutaneous chromoblastomycosis, 4% for phaeohyphomycotic brain abscess, 3% for other forms of chromoblastomycosis, and 17% for an unspecified form of chromoblastomycosis. For sporotrichosis, most patients (75%) had an ICD-10 code for unspecified sporotrichosis, 13% for lymphocutaneous disease, 3% for arthritis, 2% for pulmonary infection, and <1% each for cerebral or disseminated; 9% had an ICD-10 code for other forms of sporotrichosis. For mucormycosis, most patients (68%) had an ICD-10 code for an unspecified form of disease, 15% for pulmonary disease, 13% for rhinocerebral, 11% for cutaneous disease, 3% for disseminated disease, 2% for gastrointestinal disease, and 4% for other forms of disease.

Table II.

Results from nested-case control analyses examining underlying conditions associated with implantation mycoses, adjusting for age, sex, and US census region—United States, 2017 to 2021*

	Chromoblastomycosis and phaeohyphomycotic abscess (*n* = 609)		Sporotrichosis (*n* = 512)		Mucormycosis (*n* = 427)		Eumycetoma (*n* = 211)	
Underlying conditions	**No. (%)**	**aOR, 95% CI**	**No. (%)**	**aOR, 95% CI**	**No. (%)**	**aOR, 95% CI**	**No. (%)**	**aOR, 95% CI**
Diabetes mellitus	99 (16.3)	2.35 (1.82–3.03)	52 (10.2)	1.04 (0.76–1.43)	123 (28.8)	3.63 (2.81–4.68)	33 (15.6)	1.75 (1.15–2.66)
Dyslipidemia	109 (17.9)	1.03 (0.80–1.33)	108 (21.1)	1.56 (1.21–2.00)	116 (27.2)	1.14 (0.88–1.48)	38 (18.0)	0.84 (0.56–1.27)
Hypertension	166 (27.3)	2.37 (1.88–3.00)	112 (21.9)	1.12 (0.87–1.44)	174 (40.7)	2.78 (2.15–3.59)	67 (31.8)	2.38 (1.67–3.40)
Immunosuppressive conditions and medications	92 (15.1)	2.55 (2.03–3.21)	90 (17.6)	2.57 (2.04–3.23)	203 (47.5)	12.31 (10.06–15.08)	56 (26.5)	4.28 (3.12–5.86)
Cancer	34 (5.6)	—	19 (3.7)	—	131 (30.7)	—	15 (7.1)	—
IMID	21 (3.4)	—	25 (4.9)	—	27 (6.3)	—	7 (3.3)	—
HIV	3 (0.5)	—	1 (0.2)	—	4 (0.9)	—	0 (0.0)	—
SOT/SCT	6 (1.0)	—	2 (0.4)	—	71 (16.6)	—	7 (3.3)	—
Immunosuppressive medication receipt	44 (7.2)	—	59 (11.5)	—	83 (19.4)	—	40 (19.0)	—
Prednisone	41 (6.7)	—	51 (10.0)	—	76 (17.8)	—	36 (17.1)	—
Mycophenolate mofetil	1 (0.2)	—	1 (0.2)	—	13 (3.0)	—	3 (1.4)	—
TNF-α inhibitor†	3 (0.5)	—	8 (1.6)	—	1 (0.2)	—	2 (0.9)	—
Tacrolimus	3 (0.5)	—	1 (0.2)	—	21 (4.9)	—	3 (1.4)	—

aOR, Adjusted odds ratio; *IMID*, immune-mediated inflammatory disease; *SOT/SCT*, solid organ transplant or stem cell transplant; *TNF-α*, Tumor necrosis factor-alpha.

*This analysis includes patients who had continuous insurance enrollment during the 90 d before the initial mycosis diagnosis date. Underlying medical conditions were indicated on or within the 90 d preceding the mycosis diagnosis. Using a nested case-control study design, we performed a logistic regression to evaluate associations between underlying conditions and each mycosis, adjusting for age, sex, and region. The percentage of patients diagnosed in the inpatient setting was 5.4% for chromoblastomycosis, 4.7% for sporotrichosis, 41.0% for mucormycosis, and 3.8% for eumycetoma.

†This category includes the 5 U.S. Food and Drug Administration-approved TNF-α inhibitors: infliximab, adalimumab, etanercept, golimumab, and certolizumab.