

Classification of Mycoses

Sex in Fungi

Fungi, in addition to producing asexual spores or conidia, can undergo meiosis. Genetic coupling of non-identical DNA occurs during meiosis, resulting in progeny with a new combination of the genes that were present in the parental haploid genomes. Diversity is produced by recombination of homologous chromosomes and crossing-over of chromosomal segments. This process results in a new and unique set of chromosomes, which, seen on a large scale, increases the level of genetic diversity in the entire population. With only mitosis, there would be no sharing of genetic information between compatible mating types; only division would be possible. The structures specialized to accomplish meiosis are the foundation used to classify fungi into **Orders, Families, Genera,** and **Species**.

Anamorph and Teleomorph Nomenclature

The asexual state of fungi is termed the **anamorphic** state, while the sexual state is termed the **teleomorphic** state: for example, *Histoplasma capsulatum* (anamorph) and *Ajellomyces capsulatus* (Teleomorph). In both medicine and clinical laboratory practice, however, the anamorph names persist so as to avoid confusion in understanding the actual fungus.

Classification of Mycoses based on the primary site of pathology

The thrust of medical mycology is to understand fungi as the causative agents of disease in humans and lower animals. This is the major difference between medical and general mycology.

1- Superficial Mycoses

Pityriasis versicolor is a mild infection of the nonliving keratinized outer layer of the epidermis caused by lipophilic yeasts, *Malassezia* species, and is mostly a cosmetic issue. More serious bloodstream infections caused by *Malassezia* species do occur, most often in neonates.

2- Cutaneous Mycoses

Dermatophytes or "ringworm" fungi cause disease of the skin, hair, and nails. These fungi are restricted to grow only on nonliving keratinized tissues. Dermatophytosis agents are, in order of prevalence, *Trichophyton tonsurans* > *T. rubrum* > *T. interdigitale* > *Microsporum canis*. Skin lesions may also be the cutaneous manifestations of deep-seated systemic mycoses: that is, the skin is a frequent site of dissemination for *Blastomyces dermatitidis*.

3- Systemic Opportunistic Mycoses

Systemic opportunistic mycoses cover a wide range of etiologic agents and clinical forms caused by molds and yeasts including **environmental fungi** and **endogenous commensal** fungi of the human microbiota (Table 2). Persons with normal immune and endocrine functions have normal levels of natural immunity sufficient to prevent these diseases.

4- Subcutaneous Mycoses

Usually initiated by a puncture with a thorn or splinter, this broad category of mycoses caused subcutaneous disease, in which **melanized** molds and their yeast-like relatives play an important role (Table 2).

5- Endemic Mycoses caused by Dimorphic Environmental Molds

Endemic mycoses have a restricted geographic distribution as shown in Table 3. Most are primary pulmonary pathogens affecting immune-normal as well as immunocompromised persons. Exceptions are the dimorphic pathogens,

Penicillium marneffei and ***Sporothrix schenckii***. ***Penicillium marneffei*** is an opportunistic endemic mycosis, causing pulmonary and disseminated disease in immunocompromised persons, especially in AIDS patients living in or traveling to Southeast Asia. **Sporotrichosis** is distributed worldwide but has regions of high endemicity. It is most often a subcutaneous mycosis caused by a penetrating injury with a thorn or splinter, but can spread by direct extension to joints and other organs.

Table 2. Systemic Opportunistic Mycoses and Subcutaneous Mycoses.

Category	Mycosis	Examples of etiologic agent(s)
Systemic mycoses caused by opportunistic yeasts	Candidiasis	<i>Candida albicans</i> , other <i>Candida</i> species
	Cryptococcosis	<i>Cryptococcus neoformans</i> , <i>Cr. Gattii</i>
Systemic mycoses caused by opportunistic molds	Aspergillosis	<i>Aspergillus fumigatus</i> , other <i>Aspergillus</i> species
	Mucormycosis,	Mucorales
	Entomophthoromycosis	Entomophthorales
	<i>Fusarium</i> mycosis	<i>Fusarium</i> species
	<i>Pseudallescheria/Scedosporium</i> mycosis	<i>Pseudallescheria boydii</i> , <i>Scedosporium apiospermum</i>
Systemic mycoses caused by other opportunistic molds	pneumocystosis	<i>Pneumocystis jirovecii</i>
Subcutaneous mycoses of implantation	Chromoblastomycosis	Dimorphic melanized molds (e.g., <i>Fonsecaea pedrosoi</i>)
	Plaehyphomycosis	Melanized yeasts and their mold relatives (e.g., <i>Exophiala jeanselmei</i>)
	Sporotrichosis	<i>Sporothrix schenckii</i>
	Eumycetoma	<i>Pseudallescheria boydii</i> , <i>Madurella mycetomatis</i>

Table 3. Endemic Mycoses Caused by Dimorphic Environmental Molds.

Endemic mycosis	Etiologic agent	Major endemic area
Histoplasmosis	<i>Histoplasma capsulatum</i>	States bordering major river valleys of central United States
Blastomycosis	<i>Blastomyces dermatitidis</i>	Overlaps with <i>Histoplasma</i> endemic area
Coccidioidomycosis	<i>Coccidioides immitis</i> , <i>C. posadasii</i>	Two major foci: Central Valley of California and Arizona endemic area
Paracoccidioidomycosis	<i>Paracoccidioides brasiliensis</i>	Brazil , Colombia
Penicilliosis	<i>Penicillium marneffei</i>	Southeast Asia
Sporotrichosis	<i>Sporothrix schenckii</i>	Worldwide with areas of high endemicity