

# The Prevalence of Invasive Fungal Infections

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## Description

Access to the appropriate tools is crucial for early diagnosis and clinical management of invasive fungal infections. This Review aims to describe the invasive fungal infection diagnostic capacity of Europe to better understand the status and the most pressing aspects that need improvement. To our knowledge, this is the first time that the mycological diagnostic capability and access to antifungal treatments of institutions has been evaluated at a pan-European level. Of the 388 participating institutions from 45 countries, 383 (99%) had access to cultures, 375 (97%) to microscopy, 363 (94%) to antigen-detection assays, 329 (85%) to molecular tests (mostly PCR), and 324 (84%) to antibody tests for diagnosis and management.

## Mycological Diagnoses

With the exception of microscopy, there were considerable differences in access to techniques among countries according to their gross domestic product. At least one triazole was available in 363 (94%) of the institutions, one echinocandin in 346 (89%), and liposomal amphotericin B in 301 (78%), with country gross domestic product-based differences. Differences were also observed in the access to therapeutic drug monitoring. Although Europe is well prepared to manage invasive fungal infections, some institutions do not have access to certain diagnostic tools and antifungal drugs, despite most being considered essential by WHO. These limitations need to be overcome to ensure that all patients receive the best diagnostic and therapeutic management.

The prevalence of invasive fungal infections continues to increase in Europe and worldwide. Europe is home to large populations at risk for invasive fungal infections, including haematological and oncological patients, patients requiring intensive medical care, recipients of solid organ transplants, and older populations. The prevalence of invasive fungal infection is increasing in the Intensive Care Unit (ICU) population, including people with respiratory viral infections, particularly influenza and COVID-19. In addition, the popularisation of travelling to areas with endemic mycoses and climate change can facilitate the emergence of cases of mycoses previously restricted to equatorial areas.

With almost 800 million inhabitants and located in the northern hemisphere, Europe presents a wide diversity in terms of environmental climates, access to health care, and citizen income. Four European countries are located within the top ten of the highest-income countries in the International Monetary Fund list of 2021, with an average Gross Domestic Product (GDP) of greater than. However, there are also countries within Europe with lower average GDP, closer to those of countries in Africa or Asia. These discrepancies might jeopardise the access to appropriate mycological diagnoses and treatments and, therefore, result in increased death. Moreover, cases of invasive fungal infections due to strains with intrinsic or acquired resistance to available antifungals have been described. This resistance increases the need to make specialised diagnostic tools more widely available for better management of such infections.

## Haematological Cancer

The survey was answered mainly by clinical microbiologists and laboratory professionals (n=184, 47%), and by attending physicians (n=92, 24%). Most participants were affiliated with either a university hospital (n=247, 64%) or a public hospital (n=140, 36%). Analysing the target patient groups, nine of ten institutions were admitting patients with solid cancer (n=355, 91%) or haematological cancer (n=341, 88%). Approximately 85% of the institutions were also treating patients with COVID-19 (n=333, 86%), diabetes (n=331, 85%), or patients needing parenteral nutrition (n=330, 85%). All institutions except one (0.3%) had access to a microbiology laboratory, and 368 (95%) of these had a microbiology laboratory onsite. Out of these 368 institutions, 225 (61%) always performed mycological diagnostic procedures onsite, 45 (37%) performed these procedures partly onsite and partly outsourced, and 13 (3%) always outsourced the procedures.

Hence, as part of a continued effort from the European Confederation of Medical Mycology (ECMM), this review aims to describe the invasive fungal infection diagnostic capacity of Europe to better understand the current situation and the most pressing issues that need improvement. Similar studies have been performed before, although restricted to national experiences. To the best of our knowledge, this is the first time that the mycological diagnostic capability and access to

antifungal treatments of institutions has been evaluated at a pan-European level.

Data were collected via an online electronic case report form between November, 2021, and January, 2022. Before analysis, the answers from each participant were validated to ensure data coherence and completeness. The queries covered different categories; namely, institution profile, perceptions on invasive fungal infections in the respective institution, microscopy, culture and fungal identification, serology, antigen-detection, molecular assays, and therapeutic drug monitoring. In most categories, participants had to reply dichotomously to whether or not the respective technique was available in their places of work. Participants could specify availability onsite or through an outsourced institution for serology, antigen-detection molecular

tests, and therapeutic drug monitoring (if accessible). The incidence of invasive fungal infections in general, and specifically of mucormycosis, could be answered with a Lickert scale, ranging from 1 to 5.

Institutions in European sovereign states, de facto independent countries, and self-governing dependencies and regions were contacted by email and asked to participate. Mass emailing was targeted not only to close collaborators of the authors, but also members of scientific societies, such as the International Society of Human and Animal Mycology and the ECMM. Participating institutions were classified according to their country GDP per capita to analyse whether there were statistically significant differences between European countries in the availability of antifungals and diagnostic tests.