Diseases caused by fungi, with localization of the infection on the skin, in the subcutaneous tissue and in internal organs, are widely distributed throughout the world. However, owing to the scarcity of specialized diagnostic and therapeutic centres, and the fact that mycoses are not notifiable diseases, our knowledge of their prevalence and incidence is incomplete. For this reason it is difficult to evaluate their public health or socioeconomic importance.

Scientific progress in this field in the last two decades has been considerable, particularly in the development of diagnostic procedures and chemotherapy.

WHO's activities in the field of mycoses have been somewhat marginal but in conformity with the interest expressed by Member States. While budgetary constraints would not permit any significant increase in activities related to mycotic infections, the Director-General would appreciate the views of the Health Assembly on this health problem. Examples of possible courses of action in establishing services, training and field studies are mentioned.

The present report is submitted to the Health Assembly pursuant to resolution WHA28.55.¹

2. It is not the intention of this report to describe mycotic infections or to go into great
detail on their epidemiology, on the basis of the scanty data available. Nevertheless some
examples are given to demonstrate their role in human pathology and their possible importance
to public health.

3. Any subdivision of mycotic infections, based either on clinical expression or their place
in the botanical systematics, may be considered as arbitrary. However, for the sake of
convenience, mycotic diseases could be discussed on the basis of their clinical expression:
cutaneous, subcutaneous and systemic.

Cutaneous mycoses

4. Some of these diseases, such as foot ringworm (athlete's foot) rival the common cold in
prevalence and incidence. For example, surveys carried out in the United Kingdom revealed
that in certain population groups, such as coal miners, about 50% may be infected with athlete's
foot and that in the coal mining industry 100 000 man-days were lost from work as a result of
this disease during 1966 and 1967.

5. An estimate of the magnitude of the public health problem posed by cutaneous mycoses can
be derived from data on expenditure for antifungal pharmaceutical preparations. In the United
States of America, for example, over-the-counter sales of medication for foot ringworm totalled
US$ 25 million in 1959. While information on prescribed drugs is not readily available, it
is known that in the United States in 1966 patients affected by these diseases spent $ 6 700 000
on griseofulvin, a specific drug for the treatment of mycoses.

Subcutaneous mycoses

6. Chromoblastomycosis (chromomycosis), mycetoma (maduromycosis) and sporotrichosis are
amongst the principal species of fungi which invade the subcutaneous tissues and in some cases
the bones.

7. Chromoblastomycosis is especially prevalent in Africa and Latin America. The disease also
occurs to a lesser extent in other parts of the world: surveys in Costa Rica and Madagascar
have revealed infection rates of 1 per 24 000 and 1 per 32 500 persons respectively. Because
of its intractability to treatment and high incidence, chromoblastomycosis plays an important
role in human pathology in areas where it occurs.

8. Mycetomas occur with striking frequency and have a devastating effect on the life of their
victims in the tropical regions of the world. A survey in Sudan revealed that over a 30-month
period 1231 persons with this disease had been admitted to hospital. The many victims of
mycetoma lead lives of resigned desperation because, in the absence of medical services and
effective chemotherapy, they face the inevitable and irreparable loss of limbs and a desolate
future. Thus, in areas of relatively high prevalence mycetomas are of real public health
importance, with socioeconomic implications. For this reason it is important to establish in
such areas centres for early diagnosis and prompt surgical intervention for the infected
persons.

9. Sporotrichosis is well known as an occupational disease in individuals working with soil
and vegetable products. It has been estimated that in parts of Brazil the disease accounts
for 0.5% of all dermatoses. It is especially common in Mexico. During an outbreak of
sporotrichosis in South Africa almost 3000 miners developed this disease during a 28-month
period.

Systemic mycoses

10. The most serious of the mycotic diseases are those that involve the vital organs of the
human body. These are generally contracted by inhalation of the air-borne spores of the
causative agents. The principal systemic mycoses are blastomycosis, coccidioidomycosis,
cryptococcosis, histoplasmosis and paracoccidioidomycosis.
11. It is only for the United States of America that we have some statistical data on the incidence and mortality rates for most of these diseases, as shown below:

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Hospitalized cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blastomycosis</td>
<td>180</td>
<td>3</td>
</tr>
<tr>
<td>Coccidioidomycosis</td>
<td>2,084</td>
<td>42</td>
</tr>
<tr>
<td>Cryptococcosis</td>
<td>260</td>
<td>112</td>
</tr>
<tr>
<td>Histoplasmosis</td>
<td>4,006</td>
<td>56</td>
</tr>
<tr>
<td>Total</td>
<td>6,530</td>
<td>213</td>
</tr>
</tbody>
</table>

12. Blastomycosis is known with certainty to be endemic only in the North American continent, parts of Africa and the Eastern Mediterranean.

13. Coccidioidomycosis is also a disease of limited geographical distribution. It is endemic in North, Middle and South America. In the entire endemic area of the United States of America the annual total of new infections is approximately 100,000 and more than one-third of these develop overt signs of disease.

14. Cryptococcosis is one of the most serious and dreaded of the systemic mycoses. Its etiological agent has a marked tendency to invade the central nervous system, causing sub-acute or chronic meningoencephalitis. Cases of this disease have been reported in virtually all parts of the world. In many instances the diagnosis is established late; hence the high mortality rate that has been recorded for this disease. The primary infection of lungs, kidneys, prostate, bone or liver often causes mild local symptoms.

15. Histoplasmosis has a worldwide distribution, but two clinically different mycoses have been distinguished - caused, in fact, by two different species of fungi: Histoplasma capsulatum and H. capsulatum var. duboisii. The latter causes African histoplasmosis. It is estimated that millions of people are infected throughout the world by H. capsulatum, although a high percentage may only have non-apparent infection.

16. Paracoccidioidomycosis has the most restricted geographical distribution of all of the systemic mycoses. It is only known to occur in Latin America. Morbidity rates in Brazil are 2.5 cases per 100,000 inhabitants, and in Venezuela the rate has been reported to be 5 per 100,000 inhabitants.

Opportunistic fungi

17. In addition to these well-known mycotic diseases caused by primary pathogens, there are systemic mycotic diseases caused by fungi that are opportunistic and essentially only infect individuals with injured defence mechanisms. The most important diseases in this category are aspergillosis and candidiasis. The coincidence and prevalence of these two diseases have rapidly increased in recent years as a result of the widespread use of antibiotics, corticosteroids, immunosuppressive agents and radiation therapy, making patients susceptible to secondary infections by the opportunistic fungi.

18. It has been estimated that during 1970 379 cases of aspergillosis and 338 cases of systemic candidiasis required hospitalization in the United States of America, with 63 deaths due to aspergillosis and 153 to candidiasis.
19. The epidemiology of the various mycoses is directly correlated with the natural habitat of their etiological agents. Among the cutaneous fungi we have some that are primarily transferred from person to person by contact, others that are acquired from infected animals, and a third - and smaller - group where the source of infection is soil. In the subcutaneous mycoses, soil, plants or organic debris constitute the basic source of infection. This is also true of the fungi that cause systemic infections, with one exception, Candida albicans, the principal cause of candidiasis, which lives as a "commensal" organism in the body of most humans and some other animals. In this case, active and progressive infection evolves when some factor upsets the equilibrium that exists between the host and his "commensal".

20. The soil-inhabiting pathogens are not distributed at random in nature. Many are known to have quite specific ecological requirements. Coccidioides immitis is adapted to live in the semi-arid regions of the Americas. Cryptococcus neoformans flourishes in pigeon habitats where the soil is enriched with their droppings; Aspergillus fumigatus, the principal causative agent of aspergillosis, grows most abundantly in decaying vegetation, but is also present in all types of organic debris. Causative agents of mycetoma also survive in the soil and decaying vegetation.

21. The clinical diagnosis of most mycotic infections, except those with localization on the skin, is made difficult by the fact that the symptoms of some of the mycoses are similar to those of bacterial and viral diseases or tumours at the initial stage of development. Differential and definitive diagnosis must be based on both clinical evidence and appropriate laboratory findings. This involves direct microscopic examination of the etiological agents in unstained and stained preparations of bioptic material or isolation and identification of the pathogens by in vitro cultivation and by appropriate serological tests.

22. There is a scarcity of trained and experienced personnel capable of diagnosing mycotic diseases, particularly in developing countries; yet it is precisely in these areas that the incidence of these diseases is known or suspected to be extremely high, and in some of these countries mycotic infections are being treated in a side room of the hospital ward for dermatovenereology.

23. The epidemiology of most of the mycotic diseases is complicated by the following: the same disease entity may be caused by several agents; transmission may occur from animal to man; for a number of species, the reservoir is soil and decaying vegetation - a fact that makes the prevention and control of these diseases an impossible task. Early diagnosis and specific therapy are therefore the only measures currently available to reduce the morbidity and mortality caused by pathogenic fungi.

Technical advances in the field of mycotic diseases

24. In spite of the very marginal development of technical expertise in medical and veterinary mycology, scientific advances made in this field in the last two decades have been appreciable. Symptomatology, clinical and gross pathology and the course of the diseases have been defined and adequate and appropriate laboratory diagnostic techniques, involving both the isolation-identification of causative agents and serological procedures, have been developed. With the discovery of amphotericin B, flucytosine (5-fluorocytosine), griseofulvin and miconazole, significant breakthroughs have been achieved in mycoses therapy. Taxonomic studies of the causative agents of fungi have led to their appropriate placement in the botanical systematics and some progress has been made in the classification of these diseases. The present classification of mycoses according to localization of the parasitism by fungi is considered arbitrary, but it is hoped that a sound classification, important for the recording and reporting of mycoses, will be finalized within two or three years. Many ecological and epidemiological studies on favus have been carried out in the past two decades, as well as some mass control campaigns. Other epidemiological studies have revealed the type-reservoir of pathogenic fungi in nature and the way in which they are transmitted to human hosts. The immune response to infections with pathogenic fungi has been studied to a considerable extent.
and this has increased our understanding of the phenomena involved in the pathology caused by fungi. In addition to the development of serological techniques for diagnostic purposes, attempts are being made to develop immunizing agents, and a vaccine against *Coccidioides immitis* is now being evaluated in the United States of America.

25. In view of all of these advances, particularly those regarding diagnostic procedures and chemotherapy, it should be relatively easy for the national health services to establish specialized centres for diagnosis and treatment of mycoses in countries in which such centres do not yet exist.

**WHO activities in the field of mycoses**

26. WHO's activities in this field have been marginal, but in conformity with the interest expressed by Member States. These activities consisted mainly of cooperating with certain Member States in the control of favus, undertaking epidemiological field studies on sporotrichosis, providing technical expertise, through consultants, and organizing meetings, consultations or seminars (for example, the Seminar on Tropical Skin Diseases held in Manila in September 1975). Present financial constraints would not permit intensification of these activities without additional funds. However, the Organization is ready to cooperate with Member States and the Director-General would therefore appreciate receiving the views of the Assembly on the subject, more particularly on the following aspects.

(1) Mycoses are not notifiable diseases, but reportable according to the International Classification of Diseases. This aspect should receive further attention from the national health services since, without more reliable data on the prevalence and incidence of these diseases, it is impossible to appreciate their true public health importance and socioeconomic impact. The initiative taken by the International Society for Human and Animal Mycology (ISHAM) to gather further information is to be commended and encouraged. WHO would be ready to cooperate, particularly in the collation and dissemination of the data collected.

(2) In the development of specialized manpower, both professional and auxiliary, much more could be done than in the past. In the curriculum for undergraduate studies, more importance should be attached to pathogenic fungi and there should be specialization and career opportunities within the national health services. There are many centres that could organize intensive courses in medical mycology on a regional basis for countries that require such expertise.

(3) Although there is a wealth of published textbooks and manuals on medical mycology and laboratory techniques, there may be a need in some developing countries for simple manuals that would provide guidance on a more uniform application of available techniques and procedures, thus making the data obtained more comparable. Biological preparations such as antigens and antisera, require standardization, and WHO should take the necessary steps as for other communicable diseases. As for other specific subjects, the Organization intends to designate a certain number of collaborating laboratories (in consultation with ISHAM) which could help countries needing specialized expertise.

(4) In order to obtain additional information on mycotic infections, national health services are being encouraged to undertake surveys on selected mycotic diseases. The Organization is ready to cooperate with Member States by providing protocols for such surveys, the necessary technical material in terms of antigens and other diagnostic material, and consultants for carrying out the surveys.

(5) Certain mycotic diseases lend themselves readily to the development of prevention and control programmes with the technology available today. Among these diseases, favus, tinea capitis, tinea imbricata and mycetomas deserve particular attention. Case-finding procedures are simple and straightforward, and do not require expensive equipment and supplies. Effective therapeutic agents exist, and it is therefore merely a question of the degree of priority that Member States consider should be accorded to the subject.
27. To sum up, the Director-General, while appreciating the dilemma of health administrators in selecting priorities among the many health problems, wishes to bring to the attention of the Health Assembly the problem in human pathology caused by fungi and the types of activities that could be carried out at relatively little cost and would establish the basis for the prevention and control of these diseases.