NEWS, VIEWS, AND REVIEWS

From Misdiagnosis to Resistance: The Need for Antifungal Stewardship in Dermatology

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INTRODUCTION

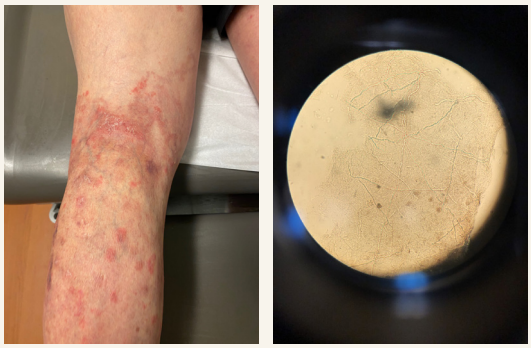
Dermatophytoses, fungal infections of the skin, hair, and nails, affect approximately 25% of the global population, and reports of antifungal therapy-resistant infections have risen over the past decade.[1] A major contributor to this trend is the widespread practice of empirically treating suspected fungal infections without diagnostic confirmation.[1]

Misdiagnosis is common, as dermatophytoses exhibit considerable clinical variability and mimic numerous inflammatory dermatoses, including secondary syphilis, annular psoriasis, and pityriasis rosea.[2] Reflecting these challenges, the American Academy of Dermatology's Choosing Wisely campaign recommends avoiding empiric oral antifungal therapy without confirmatory testing for suspected onychomycosis.[3] Nevertheless, dermatologists frequently prescribe antifungals without confirmatory testing.[4] This review examines the diagnostic gaps that contribute to inappropriate antifungal prescribing, the role these practices play in antifungal resistance (AFR), and stewardship strategies to improve accuracy and treatment outcomes.

Diagnostic Gaps in Dermatophytoses

The diagnostic evaluation of dermatophytoses includes potassium hydroxide (KOH) microscopy, fungal culture, polymerase chain reaction (PCR) testing, and histopathology.[1] KOH preparations provide inexpensive, rapid diagnosis, yet they are frequently underutilized in the clinical setting[1,4] (Figure 1). In a survey of 308 dermatologists, 20.9% "rarely" or "never" performed fungal examinations prior to prescribing antifungals, and 19.9% reported "sometimes" doing so.[4]

Figure 1. Example of a clinical presentation of tinea incognito (left) and corresponding KOH microscopy (right).



The belief that clinical examination alone is sufficient remains a major barrier, despite evidence demonstrating the high rate of visual misclassification caused by the varied presentations of dermatophytoses.[4] For example, Yadgar et al conducted an image-based survey, in which dermatologists were asked to categorize 13 clinical images as either fungal or non-fungal infections; only 8 out of 13 cases were correctly categorized more than half of the time, with only one case achieving >90% diagnostic accuracy.[2]

Diagnostic confirmation is even less common in onychomycosis, as a recent study by Gupta et al demonstrated that among 120,000 patients with suspected onychomycosis, only around 10% of patients who received oral antifungals and 16% who received topical antifungals underwent confirmatory testing.[5] This gap may be attributed to the higher costs of KOH preparation and periodic acid-Schiff (PAS) evaluation compared to empirical terbinafine treatment.[6] However, recent studies report that confirmatory testing may ultimately be less expensive than the downstream costs associated with misdiagnosis and treatment failure.[5,6]

Consequences of Empiric Antifungal Treatment

Empiric antifungal treatment for non-fungal conditions delays accurate diagnosis and care while contributing to selective pressure that fosters resistance.[2,7] AFR has become increasingly recognized globally, with terbinafine-resistant *Trichophyton rubrum* and *T. indotineae* most prominently implicated.[1] The first US case of *T. indotineae* resistant to oral terbinafine was reported in 2023, confirming AFR as a worldwide issue.[1] Resistance has since been documented across both fungicidal (eg, terbinafine) and fungistatic (eg, azoles) drug classes, reinforcing the need for stewardship.[1]

In addition to empiric use, prescribing antifungals for non-fungal conditions, such as seborrheic dermatitis (SD), adds to unnecessary exposure and may promote AFR. SD is a chronic skin disorder affecting areas of the body rich in sebaceous glands.[8] Though Malassezia yeast overgrowth is one of multiple driving factors of SD, in addition to epidermal skin barrier disruption and a dysregulated inflammatory response, it is not considered a true fungal infection; yet topical ketoconazole (1% over the counter (OTC); 2% prescription) shampoo remains first-line therapy for SD of the scalp.[8] Studies have reported elevated minimum inhibitory concentrations (MICs) in Malassezia isolates for azoles and terbinafine in SD patients,

suggesting that chronic antifungal use may drive resistance.[9] Although prospective resistance studies in SD are limited, the broad OTC availability of antifungal shampoos highlights the need to better understand the effects of their repeated use over time. SD treatment also includes anti-inflammatory agents such as once-daily roflumilast 0.3% foam, which has been proven effective in recent clinical trials and may decrease the potential risk of breeding AFR compared to antifungal shampoos.[10]

Antifungal Stewardship

The lack of diagnostic testing for suspected fungal infections, along with the rise in AFR calls for antifungal stewardship (AFS) programs. AFS aims to optimize the diagnosis, treatment, and prevention of fungal infections while minimizing the emergence of antifungal resistance.[7] Although antimicrobial stewardship programs are widely established, most are centered on antibiotic stewardship, and few formally integrate AFS, despite increasing reports of treatment failures and resistant dermatophyte strains.[7] The World Health Organization has identified antifungal resistance as a major public health concern, underscoring the need for coordinated efforts across clinical and public health systems.[7]

A core principle of AFS is ensuring diagnostic confirmation prior to treatment and discouraging empiric antifungal therapy.[1,7] At a minimum, KOH with microscopy, fungal culture, or PCR should be performed before prescribing antifungals, particularly for recurrent infections or atypical presentations.[7] Molecular-based diagnostic tools, including PCR and genomic sequencing of the internal transcribed spacer (ITS) region, should be considered when resistant dermatophytoses are suspected.[7]

Expert recommendations emphasize the importance of collaboration among dermatologists, academic centers, public health agencies, and professional societies to monitor resistant strains and coordinate effective response strategies.[1] Clinicians should report unusual or recalcitrant cases to state health departments or the Centers for Disease Control and Prevention (CDC) and avoid unnecessary antifungal exposure, including topical steroid–antifungal combination products, to minimize selection pressure.

An important yet understudied area is practitioner training. Limited research exists on dermatology residents' training in KOH preparation, their comfort with the procedure, and their willingness to perform it. This gap highlights a need for further investigation, as it may help inform strategies for addressing AFS.

CONCLUSION

The rising prevalence of antifungal resistance underscores the urgent need to strengthen diagnostic accuracy and reduce unnecessary antifungal exposure. Misdiagnosis of dermatophytoses remains common, and the reliance on empiric therapy contributes to treatment failures, delayed care, and selective pressures that promote resistance.[4,7] Antifungal stewardship programs provide a framework for addressing these gaps by emphasizing diagnostic confirmation before therapy, the adoption of molecular diagnostic tools, and improved coordination among clinicians, laboratories, and public health agencies.[7] Future studies assessing dermatology residency training on dermatophyte diagnostics may further strengthen stewardship strategies.

DISCLOSURE

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