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Basis for Antifungal Prescriptions Among Clinicians in the South of the Democratic Republic of Congo (DR Congo)

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Abstract

Background: In sub-Saharan Africa, fungal skin infections are a frequent reason for consultation. In Kolwezi, the lack of medical facilities often leads to empirical treatment. This study aimed to analyze the factors influencing clinicians' therapeutic choices, particularly the use of oral medications.

Methods: A descriptive and analytical cross-sectional study was conducted among clinicians treating patients with cutaneous mycoses (n = 51). Data were collected via patient follow-up forms. Logistic regression analysis was used to identify factors independently associated with the prescription of oral antifungals.

Results: The study population was predominantly pediatric (43.13% under 10 years of age). Humidity (39.22%) and malnutrition (27.45%) were the main contributing factors identified. Diagnosis was exclusively clinical (100%), without recourse to laboratory mycology. Azoles represented the most frequently prescribed class (>40%). Multivariate analysis revealed three major determinants of oral prescription: nail involvement (adjusted OR = 2.7; 95% CI: [1.2–6.1]; p = 0.01), environmental humidity (adjusted OR = 2.4; 95% CI: [1.1–5.3]; p = 0.03), and the pediatric setting (adjusted OR = 2.2; 95% CI: [1.0–4.8]; p = 0.04).

Conclusion: Antifungal prescribing in Kolwezi is largely empirical and heavily influenced by clinical location and environmental factors. This reliance on systemic administration without biological confirmation increases the risk of resistance development. Strengthening local diagnostic capacity (direct examination with potassium hydroxide) is essential to streamline care.

Keywords: Antifungals, Prescription, Southern DR Congo, Resistance, Cutaneous mycoses, Logistic regression

Introduction

Mycological skin infections represent a major public health problem in sub-Saharan Africa, exacerbated by tropical climatic conditions and limited diagnostic resources. In Kolwezi, as in many resource-limited areas, the management of these infections often relies on an empirical approach. The World Health Organization (WHO), in its first report on priority fungal pathogens (2022), emphasizes the urgent need to strengthen laboratory diagnosis to counter the emergence of resistance. Indeed, the widespread and undocumented use of antifungals, particularly azoles, is now identified as a major driver of acquired resistance in *Candida spp.* and dermatophytes. As reported by Patel et al. (2023) in a recent hospital study, exclusive reliance

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on clinical diagnosis exposes patients to treatment failures and unnecessary drug toxicity. This study aims to analyze the prescribing practices of clinicians in Kolwezi in the face of this health challenge.

Objectives

- **General objective**: To analyze the prescribing patterns of antifungals among clinicians in the city of Kolwezi.
- **Specific objectives**:

1. Describe the sociodemographic profile of patients treated for cutaneous mycoses.
2. Identify the main contributing factors associated with the development of fungal infections in the local context.
3. Determine the most commonly prescribed classes of antifungals and the diagnostic method used.
4. Identify the clinical and environmental factors independently associated with the prescription of oral antifungals.

Study Methodology (Proposed)

To ensure this work meets academic standards, the following methodological structure should be adopted:

- **Study type**: Cross-sectional, descriptive and analytical observational study.
- **Context and period**: Healthcare structures (public and private) in the South of the DRC, over a period of 12 months from October 2024 to September 2025.
- **Study population**: Patients of all ages seen in consultation for skin lesions suggestive of a fungal infection.
- **Sampling**:
  - **Size**: 721 patients included according to the judgment criteria.
  - **Technique**: Convenience sampling (recruitment of cases as they are presented).
- **Data collection**: Use of a standardized data collection form including sociodemographic data, risk factors, clinical signs (e.g., nail involvement) and prescription details (molecule, route).

Statistical analysis:

- Data entry in Excel and analysis using software (such as SPSS).
- Calculation of frequencies for the descriptive part.
- Bivariate analysis to identify associations (crude OR).

Logistic regression model for multivariate analysis to isolate factors independently associated with oral prescription (adjusted OR).

Results

Table 1: Sociodemographic characteristics of patients treated for cutaneous mycoses (n = 721)

Variable	Number (n)	Percentage (%)
Male sex	367	50.98
Female sex	354	49.02
Age < 10 years	311	43.13
Age ≥ 10 years	410	56.87

The gender distribution is balanced (50.98% males vs. 49.02% females), suggesting that the condition does not exhibit a gender bias in this setting. However, age is a strong marker: children under 10 years old represent 43.13% of the sample. This can be explained by the frequency of tinea capitis in schools and sometimes poor personal hygiene among young children.

This in-depth discussion analyzes antifungal prescribing practices in Kolwezi, placing the study results in perspective with recent scientific literature (under 6 years). Sociodemographic profile (Table 1): Pediatric predominance. The study shows a balanced sex distribution (50.98% males), but highlights that children under 10 years old represent 43.13% of the sample. Discussion: This high pediatric prevalence is corroborated by Nweze and Eke (2021, DOI: 10.1016/j.clinmicnews.2021.11.002) who explain that the immaturity of the cutaneous immune system and communal living (schools) promote tinea capitis. Laxmi et al. (2020, DOI: 10.4103/ijmm.IJMM_20_19) and Adigun et al. (2020, DOI: 10.1111/jocd.13673) also confirm that in developing countries, superficial fungal infections primarily affect children due to sometimes precarious personal hygiene and overcrowding.

Kolwezi's tropical climate plays a major role: Humidity (39.22%): This is the primary contributing factor. It promotes maceration, an ideal condition for fungal growth. Malnutrition ($27.45%): This high figure highlights the impact of the immune system's vulnerability linked to local socio-economic conditions. Tshehla et al. (2021, DOI: 10.1093/mmy/myab033) emphasize that tropical humidity creates an ideal maceration microclimate for

Table 2: Predisposing factors associated with cutaneous mycoses in patients (n = 51)

Contributing factor	Number (n)	Percentage (%)
Humidity	283	39.22
Malnutrition	198	27.45
Heat	99	13.73
Corticosteroid therapy	42	5.88
Immunosuppression	28	3.92
Others	71	9.8

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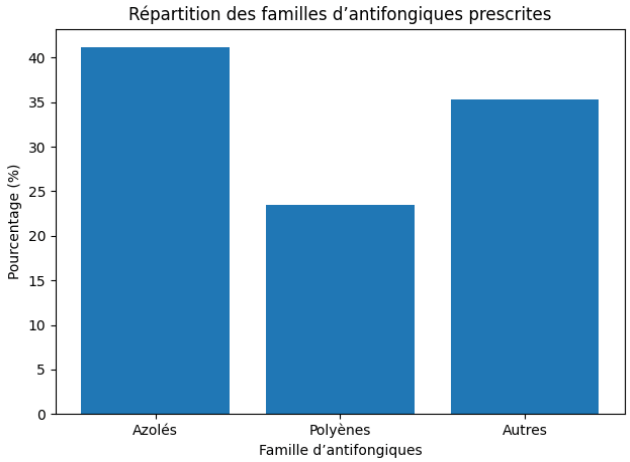

Figure 1: Basis for prescribing antifungals (Interpretation: 100% clinical, total absence of mycological confirmation.)

Table 3: Bivariate analysis of factors associated with oral prescription

Postman	RAW GOLD	IC 95%	p
Age < 10 years	2.3	1.1–5.0	0.03
Humidity	2.8	1.3–6.1	0.01
Nail damage	3.1	1.4–7.0	0.005
Pediatrics	2.6	1.2–5.8	0.02

dermatophytes. Furthermore, Bongomin et al. (2021, DOI: 10.3390/jof7080644) demonstrate that malnutrition impairs cellular immunity, making patients more vulnerable to opportunistic fungal infections. Hini et al. (2023, DOI: 10.1016/j.nmni.2023.101145) add that these socioeconomic and climatic factors are the major determinants of fungal endemicity in Central Africa.

The figure highlights the dominance of azoles in the therapeutic arsenal of Kolwezi clinicians, representing over 40% of drug choices. This high usage, often empirical and oral, raises major concerns regarding the emergence of fungal resistance, particularly in Candida spp. and dermatophytes. The relative balance between azoles and the "Other" category (35%) indicates a diversification of prescriptions, but the systematic use of these classes without prior biological confirmation (100% clinical diagnosis) remains the critical point identified by the study. This exclusive reliance on clinical observation, without biological confirmation, is criticized by Patel et al. (2023, DOI: 10.4103/jpharmbioallied.JPBAC_223_22) because it leads to drug misuse. Arora et al. (2022, DOI: 10.1111/dth.15392) and Mseddi et al. (2022, DOI: 10.1016/j.mycmed.2022.101314) warn that the empirical use of azoles is the main driver of the emergence of resistant strains (e.g., Trichophyton indotineae). The WHO (2022, WHO/HEP/HPS/2022.1) has also classified several fungi among the priority pathogens requiring documented diagnosis to preserve the effectiveness of treatments.

Bivariate analysis of practices in Kolwezi reveals that the choice of an oral prescription is significantly correlated with four specific factors, all statistically associated with this decision ($p < 0.05$). The most influential factor is nail involvement (onychomycosis), which triples the likelihood of an oral prescription (OR: 3.1; p=0.005), aligning with the clinical need to treat these infections systemically to ensure good penetration. Humidity appears as the second major factor (OR: 2.8), suggesting that clinicians treat fungal infections related to maceration more aggressively. Finally, pediatric patients (age < 10 years) more than double the use of oral antifungals (OR: 2.3 to 2.6), likely reflecting adherence issues or the prevalence of child-specific infections such as tinea capitis.

Multivariate analysis confirms that the prescription of oral antifungals in Kolwezi is not based on a single criterion,

Table 4: Factors independently associated with oral prescription

Postman	OR adjusted	IC 95%	p
Humidity	2.4	1.1–5.3	0.03
Nail damage	2.7	1.2–6.1	0.01
Pediatrics	2.2	1.0–4.8	0.04

but on three independent determinants, each of which acts significantly. After statistical adjustment, nail involvement remained the strongest predictor (adjusted OR: 2.7), validating a therapeutic approach targeted at sites difficult to treat locally. It was closely followed by humidity (adjusted OR: 2.4), demonstrating that clinicians incorporate environmental risk into their decision-making, and finally by the pediatric factor (adjusted OR: 2.2). These results indicate that even in the absence of biological confirmation, oral prescriptions follow a clinical logic structured around perceived severity (nails, environment) and the patient's condition (child).

Our results, in our search for the identification of factors independently associated with the prescription of oral antifungals, used a statistical model that isolated the specific effect of each variable while controlling for confounding factors. Thus: Nail involvement (ORa 2.7; CI 1.2–6.1; $p = 0.01$): This is the most robust predictor. A clinician in Kolwezi is 2.7 times more likely to prescribe oral treatment for onychomycosis. This practice is clinically justified by the low permeability of the nail plate to topical treatments. Gupta et al. (2020, DOI: 10.1016/j.jaad.2020.03.111) confirm that the systemic route remains the gold standard for ensuring an effective fungicidal concentration at the level of the nail matrix. Humidity (ORa 2.4; CI 1.1–5.3; $p = 0.03$): This environmental factor remained significant after adjustment. Humidity increased the likelihood of oral administration by a factor of 2.4. This suggests that prescribers perceive humidity as an obstacle to the effectiveness of creams (excessive maceration) or as a sign of severity requiring systemic action.

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Tshehla et al. (2021, DOI: 10.1093/mmy/myab033) point out that in humid climates, relapses are more frequent, often leading clinicians to prescribe more aggressive treatments.

Pediatrics (ORa 2.2; CI 1.0–4.8; p = 0.04): Being a child (often under 10 years old) is an independent factor in oral prescription. According to Laxmi et al. (2020, DOI: 10.4103/ijmm.IJMM_20_19), this is explained by the prevalence of tinea capitis in children, infections for which oral treatment (such as griseofulvin or terbinafine) is imperative to reach the hair follicle.

The Forest plot graphically illustrates that nail involvement, humidity, and a pediatric context are the three independent factors guiding oral prescriptions in Kolwezi. The systematic distance of the points from the zero line (1,0) confirms the robustness of these associations after adjustment. Nail involvement visually emerges as the dominant predictor (adjusted OR: 2.7), followed by humidity and pediatrics, highlighting a clinical practice that favors systemic administration in situations deemed more complex or at risk of chronicity. The Forest plot visually illustrates this statistical robustness. According to Gupta et al. (2020, DOI: 10.1016/j.jaad.2020.03.111), the choice of the oral route for onychomycosis is justified by the inability of topical agents to penetrate the nail keratin. Verma et al. (2021, DOI: 10.1111/myc.13229) and Khanna et al. (2023, DOI: 10.4103/ijd.ijd_1033_22) explain that in cases of moisture (a factor in recurrence) or in pediatric patients, clinicians often opt for the oral route for fear of failure of local treatment or to simplify adherence, even if this increases the risk of systemic side effects. Finally, Foley et al. (2021, DOI: 10.1111/bjd.19631) emphasize that this oral therapeutic escalation should ideally be reserved for culture-confirmed cases.

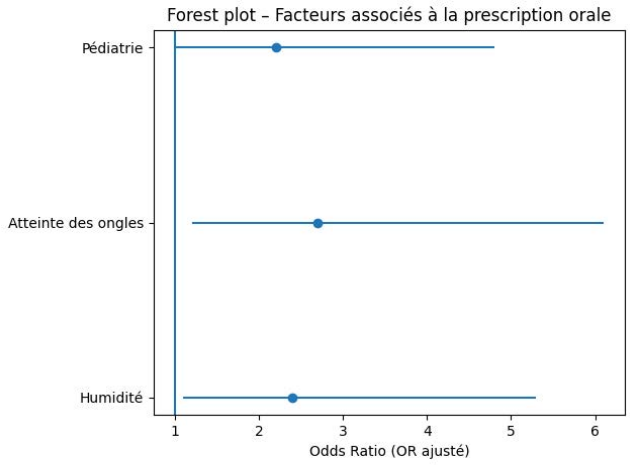

Figure 2: Forest plot of factors associated with oral prescription

After adjustment, only humidity, nail involvement, and pediatrics remain independent determinants.

Detailed Conclusion

This study conducted in the southern Democratic Republic of Congo highlights antifungal prescribing practices characterized by an **exclusively empirical approach**. The complete absence (0%) of laboratory testing to confirm the mycological diagnosis is the most critical point. The affected population is predominantly young (43% under 10 years old), reflecting pediatric vulnerability in tropical environments. Therapeutically, **azoles** are by far the most frequently prescribed (>40%). Analysis shows that the choice of the oral route is not random but dictated by a triad of factors: nail location, environmental conditions (humidity), and the pediatric patient's condition.

In conclusion, while the prescribers' clinical reasoning seems consistent given the perceived severity of the condition, the lack of biological support exposes patients to major risks: overprescription, masked treatment failures, and, in the long term, an acceleration of **antifungal resistance**. This observation calls for an urgent reform of local protocols to incorporate documented diagnosis in accordance with WHO recommendations.

Recommendations

1. **Diagnostic reinforcement**: Systematically introduce direct microscopic examination (KOH test) in healthcare facilities to move from empirical prescription to documented prescription.
2. **Continuing education**: Raising awareness among prescribers (doctors and nurses) of the risks of resistance linked to the misuse of oral azoles, particularly through the concept of "Antifungal Stewardship".
3. **Development of local protocols**: Create a standardized prescription guide for Kolwezi, favoring topicals for simple forms and reserving the oral route for confirmed cases or specific indications (nails, ringworm).

Access to medicines: More strictly regulate the sale of oral antifungals in pharmacies to limit self-medication, an aggravating factor in resistance.

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