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Exploring Medication-Related Problems, Treatment Adherence, and Patient-Reported Outcomes in Fungal Infection Management- A Narrative review

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ABSTRACT :

Background: Superficial fungal infections are common dermatological conditions that affect the skin, hair, nails and mucosal surfaces. Dermatophytosis, cutaneous candidiasis and pityriasis versicolor frequently require topical or systemic antifungal therapy, depending on the causative organism, anatomical site, disease extent and clinical severity. Despite the availability of effective antifungal agents, treatment failure, recurrence, inappropriate medication use and incomplete adherence remain challenges in clinical practice.

Objective: To review medication-related problems, treatment adherence and patient-reported outcomes associated with the pharmacological management of superficial fungal infections, with emphasis on identifying barriers to effective treatment and opportunities for optimizing pharmaceutical care.

Methods: A narrative review approach was adopted to synthesize relevant literature on antifungal pharmacotherapy, medication safety, adherence, treatment outcomes and health-related quality of life. Relevant publications, clinical practice guidelines and authoritative reports were considered. The review focuses on superficial fungal infections and the clinical implications of medication-related problems in their management.

Results: The available literature identifies several challenges in antifungal treatment, including inappropriate antifungal selection, prolonged or inadequate treatment, unsupervised medication use, topical corticosteroid–antifungal combinations, potential drug interactions and adverse drug reactions. Treatment adherence may be influenced by prolonged treatment duration, symptomatic improvement before mycological clearance, treatment complexity, cost and recurrence. Patient-reported outcomes, particularly pruritus, discomfort, cosmetic concerns, social embarrassment and impaired quality of life, provide additional information beyond clinical and mycological assessments.

Conclusion: Effective management of superficial fungal infections requires an integrated approach addressing appropriate antifungal selection, medication safety, treatment adherence and patient-centred outcomes. Clinical pharmacists can contribute through medication counselling, identification of medication-related problems, adherence assessment and monitoring of treatment-related adverse effects.

Keywords: Antifungal agents; Medication-related problems; Medication adherence; Dermatophytosis; Superficial fungal infections; Patient-reported outcomes; Quality of life.

1. Introduction

Superficial fungal infections represent a substantial proportion of dermatological conditions encountered in outpatient clinical practice. These infections primarily affect keratinized tissues, including the epidermis, hair and nails, while certain fungal organisms also involve mucosal surfaces. Dermatophytes, yeasts and lipophilic fungi are among the principal groups responsible for these conditions. Dermatophytosis, candidiasis and pityriasis versicolor constitute clinically important superficial fungal infections, with manifestations ranging from localized erythematous lesions and scaling to extensive, recurrent or persistent disease. [1]

Dermatophytosis is caused predominantly by fungi belonging to the genera Trichophyton, Microsporum and Epidermophyton. Clinical presentations include tinea corporis, tinea cruris, tinea pedis, tinea capitis and onychomycosis. Cutaneous and mucosal candidiasis are commonly associated with Candida species, whereas pityriasis versicolor is associated with Malassezia species. The clinical presentation and therapeutic requirements vary according to the causative organism, anatomical location, host factors and extent of infection. [2]

The pharmacological management of superficial fungal infections involves several classes of antifungal agents, including azoles, allylamines, polyenes and other topical antifungal preparations. Commonly prescribed agents include clotrimazole, ketoconazole, luliconazole, terbinafine, fluconazole and itraconazole. Selection of an appropriate antifungal regimen requires consideration of the suspected or confirmed pathogen, disease severity, anatomical involvement, patient comorbidities and potential drug interactions. [3]

Despite the availability of effective antifungal medications, treatment outcomes are not consistently satisfactory. Inadequate treatment duration, inappropriate drug selection, self-medication, irrational combinations and premature discontinuation may contribute to persistent infection and recurrence. The increasing recognition of difficult-to-treat dermatophytosis in India has further highlighted the need to examine prescribing practices, antifungal susceptibility and patient adherence. [4]

Medication-related problems (MRPs) constitute an important component of antifungal treatment challenges. These problems may arise from inappropriate prescribing, incorrect administration, drug–drug interactions, adverse drug reactions, inadequate monitoring and patient-related factors affecting medication use. Systemic antifungal agents, particularly azoles, may produce clinically significant interactions because of their effects on drug-metabolizing enzymes. Consequently, medication reconciliation, assessment of concomitant medications and appropriate safety monitoring are essential components of antifungal pharmacotherapy. [5]

Treatment adherence is another determinant of therapeutic effectiveness. Patients may discontinue antifungal treatment following symptomatic improvement, experience difficulties with prolonged topical application, or fail to complete prescribed systemic therapy. In addition, recurrence, treatment costs, inadequate counselling and misconceptions regarding the infectious nature of fungal diseases may influence medication-taking behaviour. Evidence from Indian dermatology practice has specifically examined adherence to topical and oral antifungal treatment in patients with dermatophytosis. [6]

Clinical improvement alone may not adequately represent the overall treatment experience. Superficial fungal infections can cause persistent itching, burning, discomfort, visible lesions, nail disfigurement and psychological distress. These manifestations may interfere with daily activities, occupational functioning, interpersonal relationships and self-esteem. Patient-reported outcome measures, including the Dermatology Life Quality Index (DLQI), provide a structured approach to assessing the impact of dermatological conditions from the patient's perspective. [7]

In this context, an integrated assessment of medication-related problems, treatment adherence and patient-reported outcomes is essential for understanding the broader challenges associated with superficial fungal infection management. This review examines these interconnected domains and discusses opportunities for improving antifungal treatment practices through patient-centred pharmaceutical care.

2. Review Methodology

2.1 Review Design

This article was developed as a narrative review to examine the relationship between medication-related problems, treatment adherence and patient-reported outcomes in the management of superficial fungal infections. The review emphasizes clinical and pharmaceutical care considerations rather than estimating pooled treatment effects or conducting a quantitative comparison of antifungal regimens.

2.2 Literature Search Strategy

Relevant literature was considered from PubMed, Google Scholar and published clinical practice guidelines. The search concepts included superficial fungal infections, dermatophytosis, cutaneous candidiasis, pityriasis versicolor, antifungal pharmacotherapy, medication-related problems, medication adherence, antifungal resistance, adverse drug reactions and health-related quality of life.

The following combinations of search terms were considered:

- "Superficial fungal infections" AND "antifungal treatment"
- "Dermatophytosis" AND "medication adherence"
- "Antifungal agents" AND "medication-related problems"
- "Antifungal therapy" AND "adverse drug reactions"
- "Dermatophytosis" AND "quality of life"
- "Fungal infections" AND "patient-reported outcomes"
- "Antifungal resistance" AND "treatment failure"

2.3 Literature Selection and Synthesis

Relevant peer-reviewed original research articles, narrative and systematic reviews, consensus statements, clinical guidelines and authoritative publications were considered based on their relevance to the review objectives. Priority was given to publications addressing antifungal treatment practices, medication safety, adherence behaviour, resistance and patient-centred outcomes.

The retrieved literature was synthesized thematically under three principal domains: medication-related problems, treatment adherence and patient-reported outcomes. Evidence gaps and implications for clinical pharmacy practice were also considered.

Methodological clarification: This is a narrative synthesis, not a systematic review. Therefore, no PRISMA flow diagram, quantitative pooled analysis or formal risk-of-bias assessment is claimed.

3. Overview of Superficial Fungal Infections

Superficial fungal infections are caused by organisms that colonize or invade the superficial keratinized tissues and mucosal surfaces. Their clinical manifestations depend on the fungal species, anatomical site, host immune response and environmental factors. Although these infections are generally not life-threatening in immunocompetent individuals, chronicity, recurrence and treatment-related difficulties can result in considerable morbidity. [1,2]

3.1 Dermatophytosis

Dermatophytosis is a fungal infection involving keratinized tissues and is primarily caused by species of Trichophyton, Microsporum and Epidermophyton. Depending on the affected anatomical region, clinical presentations include:

- Tinea corporis: infection involving the glabrous skin of the body.
- Tinea cruris: infection involving the groin and adjacent regions.
- Tinea pedis: infection involving the feet.
- Tinea capitis: infection involving the scalp and hair.
- Onychomycosis: fungal infection involving the nail unit.

The management of dermatophytosis depends on the anatomical site, extent of involvement and severity. Limited cutaneous infections are generally managed with topical antifungal agents, whereas extensive, recurrent, follicular or hair and nail involvement may require systemic treatment. [2]
In India, chronic and recurrent dermatophytosis has emerged as a significant therapeutic challenge. The increasing recognition of Trichophyton indotineae and reduced susceptibility to terbinafine in some isolates have complicated conventional treatment approaches. Molecular mechanisms involving mutations in the squalene epoxidase gene have been associated with terbinafine resistance. [3, 4]

3.2 Cutaneous and Mucosal Candidiasis

Candidiasis is caused by yeasts belonging to the genus Candida, particularly Candida albicans, although non-albicans Candida species are also clinically relevant. Cutaneous candidiasis commonly affects moist skin folds, while mucosal infections may involve the oral and genital regions.
Clinical manifestations include erythema, itching, burning, soreness and characteristic mucosal or cutaneous lesions. Predisposing factors include diabetes mellitus, immunosuppression, prolonged antibiotic exposure, moisture, occlusion and disruption of normal microbial flora.
Treatment depends on the anatomical site, severity and recurrence pattern. Topical azoles and polyenes are commonly used for localized infections, while selected cases require systemic antifungal therapy. In recurrent or complicated infections, appropriate diagnosis and consideration of the causative species are particularly important. [5]

3.3 Pityriasis Versicolor

Pityriasis versicolor is a superficial mycosis associated with Malassezia species, which are part of the normal cutaneous microbiota. The condition is characterized by hypo- or hyperpigmented macules with fine scaling, particularly over seborrhoeic areas of the trunk, neck and upper arms.
Although the infection generally responds to topical antifungal treatment, recurrence is common because of the persistent presence of Malassezia on human skin. Patients may incorrectly interpret residual pigmentary changes as evidence of persistent infection, even after successful fungal clearance. This distinction is relevant when counselling patients about treatment expectations and preventing unnecessary prolonged antifungal use. [6]

3.4 Pharmacological Management of Superficial Fungal Infections

The selection of antifungal treatment should be guided by the suspected organism, site of infection, extent of disease, previous treatment exposure and patient-specific clinical factors.

Table 1. Common antifungal agents and their therapeutic applications

Antifungal class	Examples	Principal mechanism of action	Common clinical applications
Azoles	Clotrimazole, ketoconazole, itraconazole, fluconazole	Inhibition of fungal lanosterol 14α-demethylase, disrupting ergosterol synthesis	Dermatophytosis, candidiasis and pityriasis versicolor
Allylamines	Terbinafine	Inhibition of squalene epoxidase	Dermatophytosis and onychomycosis
Polyenes	Nystatin	Binding to ergosterol and disruption of fungal cell membrane integrity	Mucocutaneous candidiasis
Hydroxypyridones	Ciclopirox	Interference with metal-dependent fungal enzymes and cellular processes	Superficial dermatophyte and yeast infections
Selenium compounds	Selenium sulfide	Reduction of fungal proliferation and epidermal turnover	Pityriasis versicolor

Source: Synthesized from published antifungal treatment reviews and clinical guidelines. [2, 5, 6]

The principal distinction between topical and systemic therapy is the extent of drug exposure and the associated safety considerations. Topical agents are generally preferred for localized infections because systemic exposure is limited. Systemic treatment may be indicated when topical therapy is inadequate or when the infection involves extensive areas, hair follicles or nails. [2]

Oral antifungals require particular attention to patient-specific contraindications, hepatic function, concomitant medications and potential drug interactions. Azole antifungals can inhibit cytochrome P450 enzymes, particularly CYP3A4, and may alter the exposure of concurrently administered medicines. Therefore, the choice and duration of systemic therapy should be individualized rather than based solely on the apparent severity of skin lesions. [5]

4. Medication-Related Problems in Superficial Fungal Infection Management

Medication-related problems are events or circumstances involving drug therapy that may interfere with the achievement of desired therapeutic outcomes. In superficial fungal infections, such problems may arise from prescribing decisions, medication administration, inappropriate self-medication, inadequate monitoring and patient-related factors.

The identification of these problems is particularly relevant in outpatient dermatology because antifungal treatment frequently involves multiple formulations, prolonged treatment courses and repeated consultations. Inappropriate medication use may contribute to persistent symptoms, recurrence, avoidable adverse effects and unnecessary healthcare expenditure.

4.1 Inappropriate Antifungal Selection

Selection of an inappropriate antifungal agent is a significant medication-related problem. Antifungal activity varies according to the organism, and not all agents are equally effective against dermatophytes, yeasts and Malassezia species.

For example, treatment selection should distinguish between dermatophyte infections and candidiasis because their causative organisms and therapeutic requirements differ. Similarly, the use of topical treatment alone may be inadequate for extensive dermatophytosis, nail infections or scalp involvement.

Inadequate diagnostic evaluation can also result in inappropriate antifungal prescribing. Conditions such as eczema, psoriasis and other inflammatory dermatoses may resemble superficial fungal infections. Prescribing antifungal therapy without appropriate clinical assessment or laboratory confirmation, when indicated, can delay the correct diagnosis and expose patients to unnecessary medication.

4.2 Irrational Fixed-Dose Combinations and Topical Corticosteroid Misuse

The inappropriate use of fixed-dose combination creams containing antifungal agents, antibacterial agents and potent topical corticosteroids is an important concern in dermatological practice, particularly in India.

Although topical corticosteroids may temporarily reduce erythema, pruritus and inflammation, their inappropriate application to dermatophyte infections can suppress local inflammatory responses and modify the clinical appearance of lesions. This may produce steroid-modified dermatophytosis, commonly referred to as tinea incognito, and complicate clinical diagnosis.

An observational study conducted in rural North India identified substantial misuse of topical corticosteroids among dermatology outpatients. The study reported that tinea was the most frequent condition for which these preparations were misused, and clobetasol propionate was the most commonly identified corticosteroid. [7]

The Indian Association of Dermatologists, Venereologists and Leprologists has also highlighted the contribution of inappropriate topical corticosteroid–antifungal combinations to the increasing burden of chronic, recurrent and steroid-modified dermatophytosis. [8]

From a medication-safety perspective, the principal concerns include:

- Inappropriate exposure to potent topical corticosteroids.
- Masking of the characteristic clinical presentation.
- Delayed recognition of persistent fungal infection.
- Potential extension or modification of lesions.
- Unnecessary exposure to multiple pharmacological agents.
- Increased treatment costs and difficulty evaluating therapeutic response.

Consequently, topical corticosteroid-containing antifungal combinations should not be considered routine treatment for uncomplicated dermatophytosis.

4.3 Incorrect Dose, Duration and Administration

Incorrect dosing and inadequate treatment duration may compromise antifungal effectiveness. Patients may apply topical preparations inconsistently, use insufficient quantities or discontinue treatment when visible lesions begin to improve.

In systemic therapy, errors may occur when patients misunderstand the prescribed frequency, duration or administration instructions. In addition, certain formulations have specific administration requirements that influence absorption.

For example, conventional itraconazole capsules have absorption characteristics influenced by gastric acidity and food intake. Acid-suppressing medications may reduce absorption of conventional itraconazole capsules, potentially affecting systemic exposure. Such interactions should be evaluated when reviewing the medication history. [9]

4.4 Potential Drug–Drug Interactions

Drug–drug interactions are particularly relevant in patients receiving systemic azole antifungals. Itraconazole is a potent CYP3A4 inhibitor, while fluconazole inhibits several cytochrome P450 enzymes. These properties may increase the plasma concentrations of concomitantly administered medicines and increase the risk of toxicity.

Potentially important interactions may involve:

- Certain statins, particularly simvastatin and lovastatin.
- Selected antiarrhythmic agents.
- Oral anticoagulants.
- Some antidiabetic agents.
- Immunosuppressive medications.
- Certain sedatives and other CYP-metabolized medicines.

The clinical significance depends on the particular antifungal, interacting medication, dose, duration and patient characteristics. A complete medication history should therefore be obtained before initiating systemic antifungal therapy. [5,9]

4.5 Adverse Drug Reactions

Antifungal agents can produce adverse drug reactions that influence treatment tolerability and adherence. The nature and severity of these reactions vary according to the pharmacological class, route of administration and duration of exposure.

Table 2. Potential adverse drug reactions associated with commonly used antifungal agents

Antifungal agent	Common or clinically relevant adverse effects
Terbinafine	Gastrointestinal disturbances, rash, taste disturbances and rare hepatotoxicity
Itraconazole	Nausea, abdominal discomfort, hepatotoxicity, oedema and potential cardiac effects
Fluconazole	Nausea, abdominal discomfort, headache, rash and hepatic enzyme abnormalities
Ketoconazole (topical)	Local irritation, burning, itching or dryness
Clotrimazole (topical)	Local irritation, erythema, burning or contact dermatitis
Nystatin	Local irritation or gastrointestinal discomfort, depending on formulation and route

Adverse drug reactions associated with systemic antifungals require appropriate clinical assessment. Patients receiving prolonged systemic treatment may require monitoring based on the selected agent, treatment duration, comorbidities and clinical presentation. In particular, hepatic safety should be considered when prescribing systemic antifungal agents with recognized hepatotoxic potential. [5, 9]

4.6 Therapeutic Failure and Antifungal Resistance

Therapeutic failure may result from several interacting factors, including incorrect diagnosis, inadequate drug exposure, poor adherence, inappropriate antifungal selection, reinfection and reduced antifungal susceptibility.

The emergence of terbinafine-resistant dermatophytes, particularly T. indotineae, has increased concern regarding the effectiveness of conventional antifungal regimens. Mutations affecting the squalene epoxidase target have been associated with reduced terbinafine susceptibility. [3,4]

However, treatment failure should not automatically be interpreted as antifungal resistance. Before modifying therapy, clinicians should evaluate adherence, dosage, treatment duration, diagnostic accuracy, reinfection and the possibility of an alternative dermatological condition.

The World Health Organization has identified antifungal resistance as an important public health concern and emphasized the need for improved surveillance, diagnostic capacity and appropriate antifungal use.[10]

5. Treatment Adherence in Superficial Fungal Infections

Treatment adherence refers to the extent to which a patient's medication-taking behaviour corresponds with the agreed recommendations of a healthcare professional. In superficial fungal infections, adherence is particularly relevant because treatment may involve repeated topical application, prolonged systemic therapy and preventive measures to minimize recurrence.

Incomplete adherence may reduce treatment effectiveness and complicate the interpretation of apparent therapeutic failure. Patients may discontinue treatment after symptomatic improvement, fail to apply topical preparations consistently or modify the prescribed regimen without consulting the treating clinician.

5.1 Patient-Related Factors Influencing Treatment Adherence

Several patient-related factors may influence adherence to antifungal treatment.

Perceived improvement and premature discontinuation: Reduction in itching, redness and scaling may encourage patients to discontinue antifungal

therapy before completing the prescribed course. Symptomatic improvement does not necessarily establish complete fungal eradication.

Treatment duration: Patients with chronic or recurrent dermatophytosis may require prolonged treatment and repeated follow-up. Extended treatment periods can reduce motivation, particularly when improvement is gradual.

Limited understanding of the disease: Misconceptions regarding the infectious nature of fungal conditions, transmission and recurrence may contribute to inappropriate medication use. Some patients may not recognize the importance of completing treatment or implementing preventive hygiene measures.

Stigma and psychological factors: Fungal infections involving visible body areas, the groin or nails may cause embarrassment and reluctance to seek medical advice. These concerns may also influence disclosure of medication use and follow-up behaviour.

Self-medication: Patients may independently purchase antifungal creams, reuse previously prescribed medications or change treatment based on recommendations from non-medical sources. Such practices can result in inappropriate medication selection and inconsistent treatment exposure.

5.2 Treatment-Related Factors Affecting Adherence

The characteristics of the prescribed antifungal regimen may influence treatment adherence.

- Dosage frequency: Frequent topical applications may be difficult to maintain alongside occupational and household responsibilities.
- Multiple formulations: Concurrent use of oral antifungals, topical creams, shampoos and other preparations may increase treatment complexity.
- Treatment duration: Prolonged courses may reduce patient motivation, particularly in chronic or recurrent infections.
- Local tolerability: Burning, irritation, dryness and other application-related effects may discourage continued use.
- Financial burden: Repeated purchases of antifungal preparations and consultation costs may affect treatment continuity.
- Administration requirements: Specific instructions regarding food intake, timing and concomitant medication use may complicate systemic antifungal treatment.

These factors indicate that adherence should be evaluated in relation to both patient behaviour and the complexity of the prescribed treatment regimen.

5.3 Evidence on Antifungal Treatment Adherence

Jagadeesan et al. conducted a pilot study examining patient adherence to oral and topical antifungal treatment among individuals with dermatophytosis in India. The investigation addressed adherence levels and factors potentially influencing medication-taking behaviour. The authors highlighted non-adherence as a possible contributor to the challenges associated with difficult-to-treat dermatophytosis. [11]

Another outpatient exploratory study by Mukherjee et al. examined treatment outcomes, medication adherence and quality of life among patients with dermatophytosis. The study used the Medication Adherence Rating Scale (MARS) alongside clinical and quality-of-life assessments, demonstrating the relevance of evaluating adherence together with treatment outcomes. [12]

These studies support the inclusion of medication adherence as an important component of antifungal treatment assessment. However, the available evidence should be interpreted cautiously because adherence findings from individual outpatient studies may not be generalizable to all superficial fungal infections or healthcare settings.

5.4 Assessment of Medication Adherence

Adherence assessment can be performed using direct and indirect approaches.

Table 3. Methods for assessing antifungal medication adherence

Assessment method	Description	Clinical application
Patient self-report	Direct questioning about missed doses and treatment discontinuation	Identifies common adherence barriers
Medication Adherence Rating Scale (MARS)	Questionnaire-based assessment of medication-taking behaviour	Evaluates self-reported adherence patterns
Morisky Medication Adherence Scale (MMAS)	Structured questionnaire assessing non-adherent behaviour	May be used when the appropriate licensed instrument is available
Pill count	Comparison of prescribed and remaining oral medication	Provides an indirect estimate of medication use
Prescription refill history	Assessment of medication collection patterns	Identifies possible interruptions in treatment
Follow-up assessment	Evaluation of treatment continuity and clinical response	Helps identify persistent adherence difficulties

No single adherence assessment method provides a complete representation of medication-taking behaviour. Combining patient interviews, medication history and follow-up assessment may provide a more informative evaluation.

5.5 Consequences of Poor Treatment Adherence

Inadequate adherence may have several clinical and pharmaceutical consequences:

1. Reduced exposure to the prescribed antifungal agent.
2. Delayed resolution of clinical manifestations.
3. Persistent or recurrent infection.
4. Increased likelihood of repeated consultations and treatment modifications.
5. Additional financial burden due to repeated medication purchases.
6. Difficulty distinguishing non-adherence from pharmacological treatment failure.

It is important to distinguish poor adherence from microbiological resistance. Although inadequate antifungal exposure may contribute to unsuccessful treatment, resistance is a microbiological phenomenon requiring appropriate laboratory evaluation. [10],[11]

6. Patient-Reported Outcomes in Superficial Fungal Infections

Patient-reported outcomes (PROs) are measurements of a patient's health status, symptoms, functional limitations and treatment experience obtained directly from the patient without interpretation by a healthcare professional.

In superficial fungal infections, clinical examination and mycological investigations provide important information regarding disease activity and treatment response. However, these assessments may not adequately capture the patient's experience of itching, discomfort, embarrassment, treatment burden and limitations in everyday activities.

Incorporating PROs into antifungal treatment evaluation therefore provides a broader understanding of therapeutic effectiveness.

6.1 Symptom Burden

Pruritus is among the most frequently reported symptoms associated with superficial fungal infections. Depending on the anatomical site and severity, patients may also experience burning, soreness, scaling, fissuring and discomfort.

Persistent itching may interfere with sleep, concentration and occupational activities. Repeated scratching can further aggravate local irritation and affect the patient's perception of disease severity.

In dermatophytosis, the extent of skin involvement and intensity of itching have been associated with poorer quality-of-life outcomes. A study examining superficial dermatophytosis in Indian patients reported an association between itch intensity and impairment in quality of life. [13]

6.2 Health-Related Quality of Life

Health-related quality of life (HRQoL) encompasses the physical, psychological and social consequences of a health condition and its treatment.

Superficial fungal infections may affect HRQoL through several mechanisms:

- Physical domain: Itching, irritation, burning and discomfort.
- Psychological domain: Embarrassment, reduced self-confidence and anxiety regarding recurrence.
- Social domain: Avoidance of social interactions and concerns regarding transmission.
- Occupational domain: Discomfort during prolonged standing, walking or physical activity, depending on the anatomical site.
- Treatment-related domain: Inconvenience associated with repeated medication application and prolonged treatment.

The impact may be particularly relevant in chronic dermatophytosis and onychomycosis, where visible lesions and recurrent symptoms can persist for extended periods.

6.3 Dermatology Life Quality Index

The Dermatology Life Quality Index (DLQI) is a validated dermatology-specific questionnaire designed to assess the impact of skin diseases on patients' daily lives. It contains 10 questions covering symptoms and feelings, daily activities, leisure, work or school, personal relationships and treatment-related difficulties.

The DLQI is scored from 0 to 30, with higher scores indicating greater impairment in quality of life.

Table 4. Interpretation of Dermatology Life Quality Index scores

DLQI score	Interpretation
0–1	No effect on patient's life
2–5	Small effect
6–10	Moderate effect
11–20	Very large effect
21–30	Extremely large effect

The DLQI has been used in studies involving patients with dermatophytosis and onychomycosis to quantify the impact of fungal infections on daily

functioning and psychosocial well-being.[13–15]

6.4 Quality-of-Life Impact in Dermatophytosis

Studies conducted among Indian patients have demonstrated that dermatophytosis can substantially affect quality of life.

In a cross-sectional study involving 348 patients with dermatophytosis, the mean DLQI score was 13.4 ± 7.3, indicating considerable quality-of-life impairment. The number of involved sites, affected body surface area and symptom severity were significantly associated with DLQI scores. [14]

Another study evaluating patients with superficial dermatophytosis reported a mean DLQI score of 8.2 ± 5.1. It also identified an association between itching intensity and quality-of-life impairment. [13]

These findings indicate that the burden of dermatophytosis extends beyond the presence of visible skin lesions. Symptom severity, anatomical distribution and disease extent should be considered when evaluating treatment outcomes.

6.5 Patient-Reported Outcomes in Onychomycosis

Onychomycosis may have a prolonged clinical course and can produce visible nail discoloration, thickening, brittleness and deformity. Although it is often considered a localized infection, its cosmetic and functional consequences may cause considerable psychosocial distress.

A cross-sectional study involving 100 patients with onychomycosis reported a mean DLQI score of 6.1 ± 3.3. Social embarrassment and difficulties associated with seeking treatment were among the reported concerns. [15]

A systematic review examining the effect of onychomycosis and its treatment on patient-reported quality-of-life outcomes found that treatment was generally associated with improvement in quality of life. The review also highlighted the need for validated, disease-specific outcome measures to capture the cosmetic, physical and social consequences of nail infections. [16]

6.6 Treatment Satisfaction and Patient Experience

Treatment satisfaction represents the patient's evaluation of the effectiveness, tolerability, convenience and acceptability of a prescribed therapeutic regimen.

In antifungal treatment, satisfaction may be influenced by:

- Speed of symptomatic improvement.
- Resolution of visible lesions.
- Ease of medication application.
- Tolerability of topical and systemic formulations.
- Affordability and accessibility of medication.
- Frequency of recurrence.
- Clarity of counselling and treatment instructions.

A treatment regimen may produce clinical improvement but still be poorly accepted if it involves complicated administration or undesirable adverse effects. Therefore, treatment satisfaction should be considered alongside clinical and mycological outcomes.

6.7 Integrating Patient-Reported Outcomes into Clinical Practice

PRO assessment can be incorporated into routine outpatient follow-up using validated questionnaires and structured patient interviews.

For patients with superficial fungal infections, the following outcomes may be considered:

Patient-reported domain	**Suggested assessment**
Pruritus	Numerical Rating Scale (NRS)
Pain or burning	Numerical Rating Scale
Quality of life	DLQI
Treatment satisfaction	Patient satisfaction questionnaire
Treatment convenience	Structured patient interview
Medication-taking behaviour	MARS or appropriate adherence questionnaire
Perceived improvement	Patient Global Impression of Change

These assessments may help identify patients who experience persistent symptoms despite apparent clinical improvement and those who require additional counselling or treatment modification.

Importantly, PROs should complement rather than replace clinical examination and mycological assessment.

Previous studies have evaluated antifungal medication adherence, treatment outcomes, and the impact of superficial fungal infections on patients' quality of life. A summary of relevant studies is presented in Table 5.

Table 5. Summary of studies evaluating treatment adherence and patient-reported outcomes in superficial fungal infections

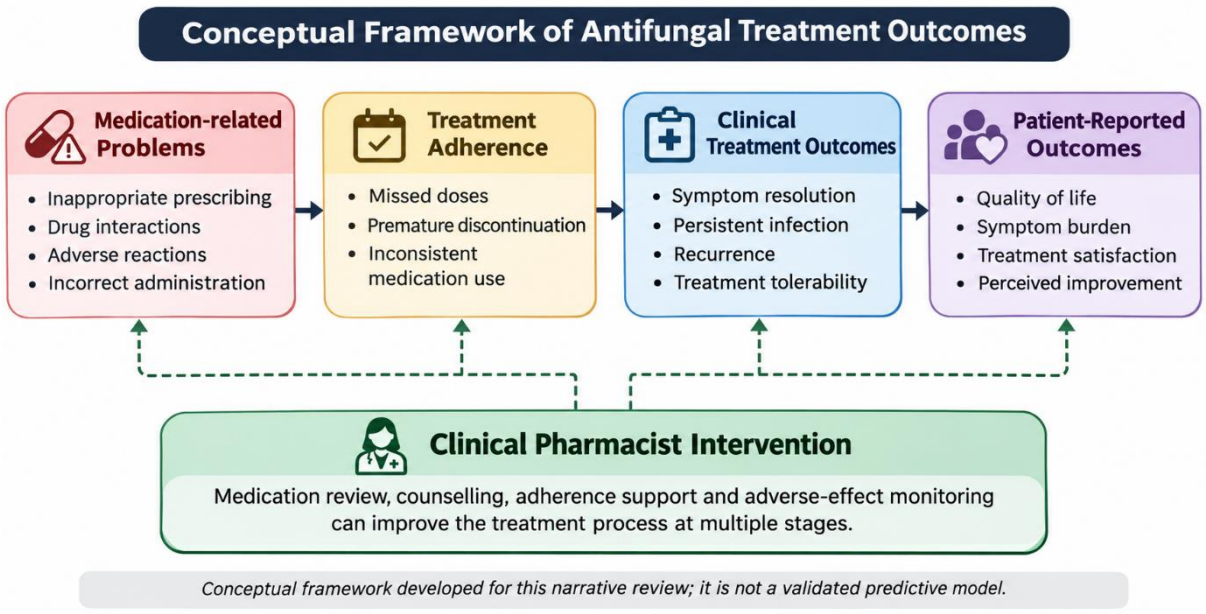
Author, year	Study design	Study population	Assessment tool	Major findings
Jagadeesan et al., 2022	Pilot study	Dermatophytosis	Adherence assessment	Antifungal adherence
Mukherjee et al., 2021	Prospective exploratory study	Dermatophytosis	MARS, QoL measures	Adherence and treatment outcomes
Verma et al., 2021	Observational study	Dermatophytosis	DLQI, itch NRS	Quality-of-life impairment
Mushtaq et al., 2020	Cross-sectional study	Dermatophytosis	DLQI	Disease-related QoL burden
Singal et al., 2020	Cross-sectional study	Onychomycosis	DLQI	Psychosocial impact
Stewart et al., 2021	Systematic review	Onychomycosis	Patient-reported measures	QoL changes following treatment

7. Interrelationship Between Medication-Related Problems, Treatment Adherence and Patient-Reported Outcomes

Medication-related problems, treatment adherence and patient-reported outcomes are interconnected components of antifungal treatment effectiveness. Inappropriate medication selection, incorrect administration and adverse drug reactions may compromise treatment tolerability and effectiveness. These problems can subsequently influence adherence and patient satisfaction. Similarly, poor adherence may contribute to persistent symptoms, recurrence and reduced quality of life.

For example, a patient receiving an unnecessarily prolonged antifungal regimen may experience increased treatment burden and become less willing to continue therapy. Conversely, inadequate treatment resulting from premature discontinuation may contribute to persistent infection and psychological distress.

The relationship can be conceptualized as follows:



This framework emphasizes that successful antifungal treatment should not be evaluated solely by the disappearance of lesions. Appropriate medication use, sustained adherence, tolerability and improvement in patient-reported health status should also be considered.

8. Role of Clinical Pharmacists in Optimizing Antifungal Therapy

Clinical pharmacists can contribute to the management of superficial fungal infections by identifying medication-related problems, promoting appropriate antifungal use, supporting treatment adherence and monitoring medication safety. Their involvement is particularly relevant in outpatient settings where patients may receive multiple medications, use non-prescribed topical preparations or require repeated antifungal treatment.

8.1 Medication Review and Identification of Medication-Related Problems

A structured medication review can help identify actual and potential medication-related problems before and during antifungal treatment.

The clinical pharmacist should assess:

- Appropriateness of the prescribed antifungal agent.
- Dose, frequency and duration of treatment.
- Suitability of topical versus systemic therapy.

- Use of inappropriate corticosteroid-containing combination creams.
- Potential drug–drug interactions.
- Previous history of antifungal treatment failure.
- Relevant comorbidities and contraindications.
- Adverse drug reactions and treatment tolerability.

Medication reconciliation is particularly important before initiating systemic azole therapy because of the potential for clinically significant interactions with concomitant medications.

8.2 Patient Counselling and Medication Education

Patient counselling is essential for improving understanding of antifungal treatment and reducing inappropriate medication use.
Counselling should address:

1. The nature and expected course of the fungal infection.
2. Correct application of topical antifungal preparations.
3. Importance of following the prescribed treatment duration.
4. Avoidance of unsupervised medication discontinuation.
5. Potential adverse effects of antifungal agents.
6. Risks associated with inappropriate topical corticosteroid use.
7. Importance of follow-up in persistent or recurrent infections.

Patients should also be advised against sharing personal items such as towels, clothing and footwear when relevant to the infection and its transmission.

8.3 Improving Medication Adherence

Clinical pharmacists can identify adherence barriers through structured interviews and medication-taking assessments. Individualized counselling may help address misconceptions, treatment complexity and concerns regarding adverse effects.
Potential interventions include:

- Providing written medication instructions.
- Explaining the correct frequency and duration of treatment.
- Simplifying medication schedules when clinically appropriate.
- Using reminder strategies for prolonged treatment courses.
- Encouraging patients to report adverse effects rather than discontinuing therapy independently.
- Reinforcing follow-up appointments.
- Addressing concerns regarding treatment costs and availability.

The effectiveness of these interventions should ideally be evaluated using validated adherence measures and relevant clinical outcomes.

8.4 Monitoring Adverse Drug Reactions and Drug Interactions

Clinical pharmacists can support the safe use of systemic antifungals by reviewing concomitant medications, identifying potential interactions and recommending appropriate monitoring to the prescribing clinician.
Patients receiving systemic antifungal agents should be counselled regarding relevant adverse effects and instructed to seek medical assessment when concerning symptoms develop. Where clinically indicated, the pharmacist can support the monitoring of liver function and other relevant safety parameters.

8.5 Assessment of Patient-Reported Outcomes

The pharmacist's role may extend beyond medication safety and adherence to the assessment of patient experience.
The DLQI, symptom rating scales and structured treatment-satisfaction assessments can be incorporated into follow-up consultations to identify patients experiencing persistent symptom burden or treatment-related difficulties.
Monitoring these outcomes may help identify discrepancies between clinical improvement and patient-perceived benefit, allowing the healthcare team to modify counselling and management strategies appropriately.

8.6 Pharmacist-Led Antifungal Stewardship

Antifungal stewardship refers to coordinated interventions that promote appropriate antifungal selection, dosing, administration and duration while minimizing unnecessary exposure and resistance-related concerns.
In outpatient dermatology, pharmacists can contribute by:

- Supporting rational antifungal prescribing.
- Discouraging inappropriate use of antifungal–corticosteroid combinations.
- Encouraging diagnostic confirmation when clinically indicated.
- Identifying unnecessary duplication of antifungal therapy.

- Reviewing systemic antifungal prescriptions for interactions.
- Promoting patient education regarding medication use.
- Supporting documentation of adverse drug reactions.

Such interventions may improve the quality of antifungal pharmacotherapy and contribute to more rational medication utilization.

9. Challenges and Gaps in Current Evidence

Although medication-related problems, treatment adherence and patient-reported outcomes are clinically relevant in superficial fungal infections, the available literature has several limitations.

9.1 Limited Evidence on Medication-Related Problems

Most published studies on superficial fungal infections primarily focus on clinical presentation, treatment effectiveness, epidemiology and antifungal susceptibility. Comparatively less attention has been directed towards systematic identification and classification of medication-related problems in routine outpatient practice.

Further research is required to establish the frequency and clinical significance of inappropriate antifungal selection, drug interactions, medication errors and adverse drug reactions in dermatology outpatient populations.

9.2 Limited Adherence Research

Although adherence has been examined in individual dermatophytosis studies, evidence remains limited across different superficial fungal infections. The factors influencing adherence may differ between patients receiving short-course topical treatment and those requiring prolonged systemic therapy. There is a need for larger prospective studies using validated adherence assessment instruments and standardized follow-up procedures.

9.3 Inconsistent Assessment of Patient-Reported Outcomes

Quality-of-life assessments are not consistently incorporated into routine antifungal treatment evaluation. While DLQI has been used in dermatophytosis and onychomycosis studies, other aspects of patient experience, including treatment satisfaction, medication burden and perceived symptom improvement, remain less extensively investigated.

The development and use of disease-specific patient-reported measures may provide a more comprehensive understanding of the burden associated with individual fungal infections.

9.4 Limited Integration of Pharmaceutical Care

The contribution of clinical pharmacists to antifungal medication management remains an area requiring further investigation. Prospective interventional studies could evaluate whether pharmacist-led medication review, adherence counselling and adverse-effect monitoring improve treatment outcomes and patient satisfaction.

9.5 Need for Evidence from Indian Outpatient Settings

India has experienced substantial challenges associated with chronic and recurrent dermatophytosis, inappropriate topical corticosteroid use and emerging antifungal resistance.[7],[8]

However, evidence integrating medication-related problems, adherence behaviour and patient-reported outcomes within the same outpatient population remains limited. Multicentre studies may help identify regional differences in medication-use practices and provide evidence to guide targeted pharmaceutical care interventions.

10. Discussion

The literature reviewed indicates that the effective management of superficial fungal infections involves considerations extending beyond the selection of an appropriate antifungal agent. Medication-related problems, treatment adherence and patient-reported outcomes represent interconnected domains that influence the overall quality of antifungal treatment.

Inappropriate medication use is a significant concern, particularly in the management of dermatophytosis. The widespread availability and misuse of topical corticosteroid-containing combination preparations may modify clinical manifestations and complicate disease management. Observational evidence from India demonstrates that inappropriate topical corticosteroid use is associated with tinea incognito and extensive disease presentations. [7],[8] These findings reinforce the need for rational prescribing, patient education and appropriate medication review.

The emergence of difficult-to-treat dermatophytosis further emphasizes the importance of appropriate antifungal selection and stewardship. Terbinafine resistance associated with T. indotineae has complicated conventional treatment approaches. However, treatment failure should be evaluated systematically, considering diagnostic accuracy, adherence, treatment duration and potential reinfection before attributing poor response to antifungal resistance. [3],[4]

Treatment adherence represents another important determinant of therapeutic success. The available Indian studies examining adherence in

dermatophytosis indicate that patient medication-taking behaviour deserves greater attention in outpatient treatment. [11],[12] Nevertheless, adherence evidence remains limited, and further research is needed to determine how patient characteristics, treatment complexity, adverse effects and counselling influence long-term medication use.

Patient-reported outcomes provide complementary information regarding the burden of superficial fungal infections. Studies using DLQI have demonstrated that dermatophytosis can significantly affect symptoms, daily activities and psychosocial well-being.[13],[14] Similarly, onychomycosis has been associated with cosmetic and social difficulties, with quality-of-life improvements reported following treatment.[15],[16]

An important implication is that clinical response and patient-perceived improvement may not always occur simultaneously. For instance, residual pigmentary changes following successful treatment of pityriasis versicolor may cause patients to perceive treatment failure. Similarly, persistent nail abnormalities following effective antifungal treatment may affect patient satisfaction because normal nail appearance requires time to return. Patient counselling should therefore include realistic expectations regarding symptom resolution, fungal clearance and the time required for tissue recovery.

The integration of medication review, adherence assessment and patient-reported outcome evaluation may provide a more comprehensive approach to outpatient antifungal care. Clinical pharmacists are well positioned to contribute to this process through medication reconciliation, interaction screening, patient counselling and treatment monitoring.

However, the evidence supporting specific pharmacist-led interventions in superficial fungal infections remains insufficient to establish their comparative effectiveness. Further prospective studies should evaluate whether structured pharmaceutical care improves adherence, reduces medication-related problems and produces meaningful improvements in patient-reported outcomes.

Overall, a patient-centred approach that combines rational antifungal prescribing with adherence support and assessment of quality of life may help improve the management of superficial fungal infections.

11. Clinical Implications and Future Perspectives

The findings of this review have several implications for clinical practice and future research.

For dermatologists: Treatment decisions should incorporate appropriate diagnostic evaluation, rational antifungal selection and assessment of previous treatment exposure. Persistent or recurrent infections warrant evaluation of adherence, possible reinfection and antifungal susceptibility where indicated.

For clinical pharmacists: Structured medication review and patient counselling may help identify inappropriate antifungal use, potential interactions and adherence barriers. Pharmacist involvement should be integrated into outpatient medication management where feasible.

For patients: Education regarding the correct use of antifungal preparations, treatment duration, avoidance of unsupervised corticosteroid combinations and preventive hygiene practices should form part of routine care.

For researchers: Future studies should consider evaluating all three major domains simultaneously.

Potential research priorities include:

1. Prevalence and classification of medication-related problems among patients receiving antifungal treatment.
2. Factors associated with poor adherence to topical and systemic antifungal medications.
3. Association between medication-related problems and treatment outcomes.
4. Relationship between adherence scores and patient-reported quality of life.
5. Effectiveness of pharmacist-led counselling and medication review interventions.
6. Development of integrated assessment models incorporating clinical outcomes, medication safety and patient-reported measures.

A prospective outpatient study incorporating a validated adherence scale, a structured medication-related problem assessment and DLQI measurement could provide useful evidence regarding the relationship between medication use and patient-centred treatment outcomes.

12. Limitations of the Review

This review has certain limitations. As a narrative review, it does not involve a predefined systematic study-selection process, quantitative synthesis or formal assessment of risk of bias across all included studies. The available literature is also heterogeneous in terms of fungal infection types, treatment regimens, adherence assessment methods and patient-reported outcome instruments.

Furthermore, evidence regarding medication-related problems and pharmacist-led interventions specifically in superficial fungal infections remains relatively limited. Some findings are derived predominantly from dermatophytosis studies and may not be directly generalizable to candidiasis or pityriasis versicolor.

These limitations should be considered when interpreting the findings and applying them to clinical practice.

13. Conclusion

Superficial fungal infections present several challenges in outpatient clinical practice, particularly in relation to appropriate antifungal selection, medication safety, treatment adherence and recurrence. Medication-related problems such as inappropriate prescribing, incorrect treatment duration, potential drug interactions, adverse drug reactions and unsupervised use of corticosteroid-containing combination preparations may compromise therapeutic outcomes.

Treatment adherence is influenced by patient-related, medication-related and socioeconomic factors, while patient-reported outcomes reflect the physical, psychological and social burden associated with these infections. Consequently, clinical improvement alone may not adequately represent the overall effectiveness of antifungal treatment.

An integrated approach incorporating rational antifungal prescribing, structured medication review, adherence assessment and validated patient-reported

outcome measures may improve the quality of outpatient antifungal care. Clinical pharmacists can contribute through medication counselling, identification of medication-related problems, interaction screening and monitoring of treatment tolerability.

Further prospective research is warranted to establish the relationship between medication-related problems, treatment adherence and patient-reported outcomes and to determine the effectiveness of pharmacist-led interventions in superficial fungal infection management.

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