

A COST VARIATION ANALYSIS OF ORAL AND TOPICAL ANTIFUNGAL AGENTS AVAILABLE FOR THE TREATMENT OF SUPERFICIAL FUNGAL INFECTIONS IN INDIA – AN INSIGHT TO THE RISING TREATMENT COST

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ABSTRACT

Objective: This study objective was to evaluate the cost variation among systemic and topical antifungal drugs used for superficial fungal infection which is available in India.

Methods: This cross-sectional study assembled the cost of individual antifungal agents belonging to the same strength and dosage forms being manufactured by different pharmaceutical companies in India were documented in Indian Rupees (INR). The study tools were the latest edition January–April 2022 of Current Index of Medical Specialties and 1 mg online application. The study parameters were minimum and maximum cost, difference in maximum and minimum cost, and percentage cost variation.

Results: A total of 14 antifungal agents, including seven orals and seven topical, were analyzed. Fluconazole 50 mg tablet is manufactured by 67 companies and has the maximum cost variation of 2695.8%. This is followed by capsule itraconazole 100 mg (cost variation – 1900%) and is manufactured by largest number of companies, that is, 1039. Luliconazole 30 g cream has highest cost ratio of 13.75 and cost variation of 1275% which was manufactured by largest number of companies, that is, 211. There was a linear relationship seen in linear regression analysis between number of manufacturing companies and percentage cost variation ($p=0.0204$).

Conclusion: A rationale prescription should always consider the most economical treatment depending on the patient. Adequate information to medical practitioner about cost variation of drugs and strict actions and coordination of regulatory authorities will overcome the problem of huge cost variation.

Keywords: Cost variation analysis, Antifungal agents, Superficial fungal infections, Pharmacoeconomics.

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INTRODUCTION

Fungal diseases are one of the most frequently encountered infectious diseases, particularly in tropical countries like India. Majority of them present as superficial fungal infections (SFIs) and are usually limited to the skin layers, hair, or nails. The lifetime prevalence of SFI worldwide has been estimated to be approximately 25% [1]. The most common causative agents are dermatophytes, yeast, and rarely non-dermatophyte filamentous fungi [2].

The risk factors associated with higher incidence of fungal infections include immunosuppression due to cancer chemotherapy, organ transplant, HIV infection, long-term use of corticosteroids, and irrational use of broad spectrum antibiotics [1]. Although SFIs are not life threatening, they are considered as disease of high public importance due to their worldwide distribution and associated morbidity [3]. Since these SFIs require long-term therapy, the accumulated cost of treatment is adds up to be very high for the patient [4].

In developing countries like India, the major part of treatment cost is contributed by the drug cost and has to be borne by the patient himself. It is a crucial issue not only for the patients but also for the healthcare providers and policy makers [5]. Increased cost of treatment deteriorates the patient compliance which ultimately delays or fails the treatment outcome. This has led to the increased significance of cost benefit analysis of various drugs and promote the use of drugs with minimum cost without affecting their efficacy [6].

Indian pharmaceutical industry is the largest pharmaceutical market in the world. It owns a number of branded and generic formulations of

the same drug. There is a substantial variation in drug costs that create problems to both the prescriber as well as the patient [7]. The major challenges faced by physicians in providing cost effective treatment are wide cost variation of drugs and inadequate knowledge about drug pricing, drug quality, and bioequivalence of drugs [8].

Therefore, pharmacoeconomics should be ascertained a critical role in drug prescribing. A significant consideration should be given to the cost of drug therapy which will result in increased adherence to the therapy. The role of pharmacoeconomics is to identify, measure, and compare the costs and consequences of pharmaceutical products [9-11].

Although there are regulations in regard to drug pricing in India, rampant use of antifungal agents with unnecessary high cost continues. Numerous antifungal agents are launched in market every day. There is limited data regarding pharmacoeconomics of antifungal drugs specially in the current scenario. We envisage this study with the aim to evaluate the price variation pertaining to both systemic and topical antifungal drugs available in Indian market.

Aims and objectives

This study aims to evaluate the cost variation among systemic and topical antifungal drugs used for SFI which is available in India.

METHODS

This is a cross-sectional study conducted in the Department of Pharmacology, Bundelkhand Medical College, Sagar (M.P). The study tools were the latest edition January–April 2022 of Current Index

of Medical Specialties (CIMS) and 1 mg online application. These sources cover most of the drugs available in Indian market. The cost of individual antifungal agents belonging to the same strength and dosage forms being manufactured by different pharmaceutical companies in India were documented in Indian Rupees (INR). CIMS is a well-established trusted source of commercial drug information used by most of the medical practitioners in India. But not all the brands are listed in it, so the 1 mg online application was used to complete the list. Drug-related information is readily available in this application. Fixed dose combinations (FDCs) of an antifungal agents agent with other or with steroids were excluded from the study. The cost per tablet or same strength was used for per unit cost calculation for oral and topical preparations, respectively.

The data were recorded in an Excel sheet. The study parameters were minimum and maximum cost, difference in maximum and minimum cost of a drug manufactured by different companies and percentage cost variation of each antifungal agent was calculated. The formula used to derive cost variation is as follows –

$$\text{Cost variation (\%)} = \frac{[(\text{Maximum cost} - \text{Minimum cost}) / \text{Minimum cost}] \times 100}{12}.$$

RESULTS

A total of 14 antifungal agents most commonly used in the treatment of SFI were studied. This included seven oral and seven topical antifungal agents from “current index of medical specialties” and 1 mg application. The most commonly available dosage and packaging formulations were selected for study analysis. Table 1 shows the number of companies manufacturing the branded version of generic oral antifungal drugs, minimum cost, maximum cost, cost range, cost ratio, and cost variation.

Among 18 formulations of oral antifungal agents, the cost variation of only four formulations is less than 100%, the remaining 14 of them have more than 100% cost variation. Fluconazole 50 mg tablet is manufactured by 67 companies and has the maximum cost variation of 2695.8%. This is followed by capsule itraconazole 100 mg (cost variation - 1900%) and is manufactured by largest number of companies, that is, 1039. The minimum cost variation of 25.71% is observed for capsule itraconazole 400 mg and is manufactured by only three companies. This suggests a linear relationship between number of manufacturing companies and percentage cost variation. The cost ratio of 14 formulations is more than 2. The agents with highest cost ratio were fluconazole 50 mg (cost ratio - 27.9) and itraconazole 100 mg (cost ratio - 20).

Table 2 depicts a total of seven generic topical antifungal drugs, their number of manufacturing companies, minimum cost, maximum cost, cost range, cost ratio, and cost variation.

Among the seven topical antifungal agents, Luliconazole 30 g cream has highest cost ratio of 13.75 and cost variation of 1275% and is manufactured by largest number of companies, that is, 211. Minimum cost variation of 275% is seen with Ketoconazole 30 g cream and is manufactured by 82 companies. Cost ratio was minimum for Sertaconazole 30 g cream which was 2.1 and is manufactured by 32 companies.

There was a linear relationship between number of manufacturing companies and percentage cost variation when a linear regression analysis ($p=0.0204$) was performed. The Spearman correlation analysis showed a significant positive correlation between these two variables (Spearman $r=0.8268$). The percentage cost variation increased as the number of manufacturing companies increased. The details are shown in Fig. 1.

DISCUSSION

Fungal infections of skin and nail have now become a silent epidemic affecting major parts of the country and all strata of the population. SFI though is not a life-threatening disease but has a very high impact on economic burden of the society. Irrational use, wrong dosage and duration, and use of FDC of topical antifungal agents with steroids have led to resistance to the drugs and longer duration of treatment to cure the infection. This eventually leads to a very high cost burden of treatment to the patient.

This study has revealed a high cost ratio and percentage cost variation of most of the frequently used oral and topical antifungal drugs. Cost ratio of drugs ranges from 2 to 27.95, which shows a huge price difference of generic drugs among different brands. Similarly, percentage cost variation shows a similar trend with minimum value of 28% to maximum of 2695.8%. These results are consistent with the findings of the previous studies [12,13].

To prescribe a rationale prescription, a physician should always consider the most economical treatment depending on the patient. Lack of information about pricing variation and quality of drugs leads to irrational and high economic burden to the patient. A meta-analysis has confirmed that the awareness about cost variation would help the doctors in improving their prescription pattern [14]. Hence, our study will help medical practitioner to compare cost of different drugs and prescribe more wisely for particular disease.

Table 1: Study parameters of branded version of generic oral antifungal drugs

Name of antifungal agent	Number of formulations	Dose	Number of manufacturing companies	Minimum Cost	Maximum cost	Range	Ratio	% Cost variation
Clotrimazole	1	100 mg	15	25.23	105	79.77	4.16	316.17
Fluconazole	4	50 mg	67	0.95	26.56	25.61	27.95	2695.78
		150 mg	75	4.37	45	40.63	10.3	929.74
		200 mg	44	12	48	36	4	300
		400 mg	44	11	55	44	5	400
Griseofulvin		125 mg	9	8.15	25.84	17.69	3.17	217.06
		375 mg	6	18.51	126	107.49	6.8	580.71
		250 mg	35	13.63	60	46.37	4.4	340.21
		500 mg	25	30	160	130	5.33	433.33
Itraconazole	4	100 mg	1039	5	100	95	20	1900
		200 mg	49	10	90.5	80.5	9.05	805
		400 mg	3	35	44	9	1.26	25.71
		50 mg	20	9.9	18.5	8.6	1.86	86.86
Ketoconazole	1	200 mg	9	15	40.57	25.57	2.7	170.46
Terbinafine	2	250 mg	27	9.78	31.9	22.12	3.26	226.18
		500 mg	3	17	29.14	12.14	1.71	71.41
Voriconazole	2	200 mg	5	298.5	900	601.5	3.02	201.5
		200 mg	2	2500	3200	700	1.28	28

Table 2: Study parameters of branded version of generic topical antifungal drugs

Drug	Number of formulations	Dose	Number of manufacturing companies	Minimum cost	Maximum cost	Range	Cost ratio	% Cost variation
Luliconazole	1	30 g	211	40	550	510	13.75	1275
Sertacoazole	1	30 g	32	176	369	193	2.1	109.66
Clotrimazole	1	15 g	69	8.75	94.5	85.75	10.8	980
Ketocoazole	1	30 g	82	88	330	242	3.75	275
Micoazole	1	15 g	12	18	164	146	9.11	811.11
Terbinafine	1	15 g	63	40	173	133	4.33	332.5
Ciclopirox	1	30 g	13	31	221	190	7.13	612.9

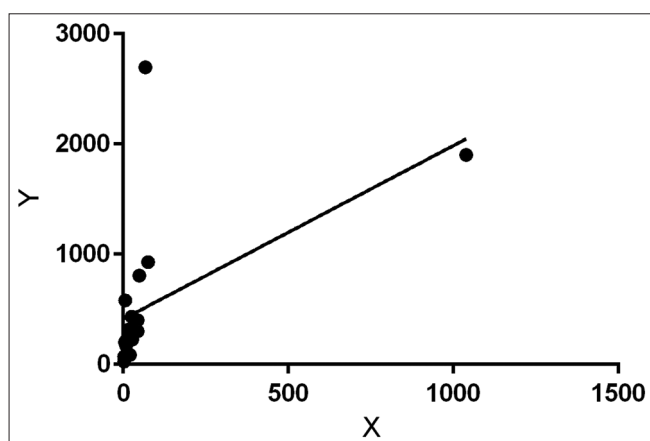


Fig. 1: Linear regression graph between number of manufacturing companies and percentage cost variation

Generic drugs are significantly lower in price than branded drugs and are considered equivalent in efficacy to innovator brands [15]. However, mostly the practitioners are hesitant in prescribing generic drugs due to quality issues and this might be a reason for prescribing costly brands [16]. Therefore, analysis of prescription costs should be included in medical curriculum so that the future healthcare providers are well aware of these issues.

Our study shows a linear relation between cost variation of drugs and number of companies manufacturing a particular drug which is inconsistent with the fact that competition brings down the cost of the drugs. Manufacturing companies cite as research, development, and better quality of drug to be the reason of high cost rather significant amount are spent on product promotion and overhead cost [17]. Incentives offered to the physicians and pharmacists by a particular brand also lead to biased prescription and dispensing of drugs leading to high cost of prescription. Higher cost of treatment indirectly leads to non-compliance of patients and further complicating the disease [18].

Better pricing policies and regulations for cost of raw material, promotion, and distribution by government can reduce wide cost variation and economic burden. Government of India has issued drug price control order (DPCO) to control the prices of essential and lifesaving drugs [19]. Cost control alone cannot reduce the burden of treatment and there is need to revise list of DPCO drugs regularly and we suggest to add most commonly prescribed antifungal agents drug with highest cost variation to be included under DPCO list.

Past studies were either done for oral or topical agents. We included both the groups in our study. Since there is a continuous increase in number of brands manufacturing antifungal drugs and no such study has been conducted in recent past, this will be a fruitful update on the use of antifungal agents. FDC of topical antifungal agents and steroid which are commonly prescribed by practitioners were not included

in the study and accounts for limitation of our study. Many brands of particular drugs are not included in CIMS and 1 mg application and hence not included in our study.

Pharmacoeconomic studies will help in proper prescribing decision making, drug policy decisions, and further coordination of manufacturing companies, physicians, pharmacist, and regulatory authorities to benefit the society by solving the problem of huge cost variation of drugs and providing affordable, efficacious treatment to the society, and hence reducing healthcare expenditure.

CONCLUSION

A high prevalence of SFI and very high cost variation of topical and oral antifungal drugs leads to unnecessary high cost of treatment and economic burden to the society. Adequate information to medical practitioner about cost variation of drugs and strict actions and coordination of regulatory authorities will overcome the problem of huge cost variation.

AUTHORS' CONTRIBUTIONS

The authors confirm contribution to the paper as follows: Study conception and design: Dr. Rajanish Kumar Sankdia. Data collection: Dr. Pawan Gupta. Analysis and interpretation of results: Dr. Lily Dubey and Dr. Shashi Marko.

COMPETING INTERESTS

The authors have no conflicts of interest to declare.

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