**Research Article**

**Economic analysis of oral cephalosporins in the Indian market**

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**ABSTRACT**

**Background:** Bacterial infections require appropriate and affordable treatment. A number of antimicrobial formulations are available in the Indian scenario. Affordable prescriptions improve compliance rate of the patients. This study was planned to evaluate & analyse the variation in the cost of oral cephalosporins (single and combination) in the Indian market.

**Methods:** Cost per tablet or capsule of cephalosporins being manufactured by different companies, in the same strength and dosage forms was obtained from two drug compendia. The difference in the maximum and minimum price and percentage variation in price was calculated.

**Results:** There are a number of companies manufacturing a particular drug, eg. Tab Cefixime (200 mg) - 127 companies, Tab Cefpodoxime (200 mg) - 106 companies, Cap Cefalexin (500 mg) - 38 companies and amongst the combinations; Tab Cefixime (200 mg) + Tab Clavulanate (125 mg) - 51 companies, Tab Cefpodoxime (200 mg) + Tab Clavulanate (125 mg) - 32 companies. A wide variation was found amongst the drugs ranging from 1746% for Tab Cefpodoxime (200 mg) to just 8.4% for Tab Cefdinir (100 mg). A similar variation existed for the combination drugs 9900% for Tab Cefixime (250 mg) + Tab Ornidazole (500 mg) and 42.1% for Tab Cefpodoxime (200 mg) + Tab Ofloxacina (200 mg).

**Conclusions:** This study shows a wide price variation of the same drugs manufactured by different companies. The manufacturing companies must aim to reduce the price variation while maintaining the quality and therapeutic efficacy in order to benefit patients and practitioners.

**Keywords:** Pharmacoeconomics, Cephalosporins, Pricing strategy, DPCO 2013, Indian patent act 2005, WHO guide to good prescribing, Reasons for price variation

**INTRODUCTION**

Bacterial infection such as lower respiratory tract infections (LRTI) is a leading cause of death in low-income and the 3rd leading cause of death in middle-low income countries. They account for about 91 deaths and 53 deaths per 1 lac population in the two groups respectively. Thus, there exists a high burden of bacterial disease and the presence of risk factors for its emergence and spread in the developing countries.

Availability of life-saving antimicrobials is of paramount importance in all countries afflicted by such infectious diseases. There exists a wide range of obstacles to the adequate access to these drugs. Issues of financing, pricing, supply, selection and distribution are crucial in this respect.

Pricing of drugs is a major factor influencing the health expenditure of the world’s poor. Unaffordable treatments in developing countries are a source of welfare losses and hampers growth by making the health capital obsolete. In developing countries 50 to 90 percent of drugs are paid out-of-pocket as a share of total health expenditures. Appropriate and good quality drugs are imperative for the benefit of patients and also at an affordable price.
With the growth of Indian pharmaceutical industry, Indian market is flooded with branded generic drugs with a lot of variation in the cost of different brands of the same formulation. This exuberant pricing is a major concern to both physician and patient. It also forms an important determinant factor influencing the compliance to treatment.

Cephalosporins, β-lactam antibiotics, are primarily indicated for the prophylaxis and treatment of bacterial infections caused by both gram positive as well as gram negative organisms. Successive generations have a broad spectrum of activity, especially against hospital acquired infections, infections caused by Klebsiella, Enterobacter, Proteus, also against sexually transmitted diseases (STDs), meningitis, community acquired pneumonia, to name a few. In the Indian market, oral cephalosporins are available in various brands. Prices of these medicines vary a lot and prescribing a cheaper brand will be an economically viable option to the patient.

In this context, this price variation of oral cephalosporins needs to be monitored. Furthermore, to the best of our knowledge no study is available which compares the cost of oral cephalosporins of different brands. So, we decided to carry out the study with the objective to project a representative view of the existing situation, by collecting data about the cost of common oral cephalosporin drugs available either singly or in combination, number of manufacturing companies for each and, to evaluate the difference in cost of different brands of same active drug by calculating percentage variation of cost.

### METHODS

The study was conducted in the Department of Pharmacology at a tertiary care hospital December 2014. Price of the drugs per tablet or capsule were reviewed from “Current Index of Medical Specialties” July-October 2014 and “Indian Drug Review” Vol. XXI, Issue No.4, 2014 for analysis of different formulations of oral cephalosporins.

The retail cost of a particular drug being manufactured by different companies, in the same strength, number and dosage forms was compared. The drug formulation being manufactured by only one company was excluded can be deleted. Difference between the maximum and minimum prices of the same drug manufactured by different pharmaceutical companies was calculated. Percentage price variation was calculated by:

\[
\% \text{ Price variation} = \frac{\text{Maximum price} - \text{Minimum price}}{\text{Minimum price}} \times 100
\]

### RESULTS

Prices of 8 oral cephalosporins were availed from the compendia. Similarly 8 cephalosporins in combination with different drugs were derived. These 16 products exist in 42 different formulations manufactured by different pharmaceutical companies. Individual prices of these formulations were analysed. There exists an extreme wide variation in the percentage price of the drugs which was found to be above 100% in most of the cases and a few of them even went above 1000%.

### Table 1: Price variation between 1st generation cephalosporins.

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Formulations</th>
<th>Doses (mg)</th>
<th>Manufacturing companies</th>
<th>Min Price per tablet (INR)</th>
<th>Max Price per tablet (INR)</th>
<th>% Price Variation</th>
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<td>Cefadroxil</td>
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<td>27</td>
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<td></td>
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<td></td>
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<td>Cap 500</td>
<td>38</td>
<td>6.3</td>
<td>50</td>
<td>693</td>
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<td></td>
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<td>Tab 750</td>
<td>8</td>
<td>18.0</td>
<td>23.9</td>
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**Single drug therapy**

There are a number of companies manufacturing a particular drug, eg. Tab Cefixime (200mg) - 127 companies, Tab Cefpodoxime (200mg) - 106 companies, Cap Cefalexin (500mg) - 38 companies. Table I shows the price variation between 1st generation cephalosporins. In this group, Cefalexin (Cap 500mg) shows maximum price variation of 693%, while Cefadroxil (Tab 750mg) shows minimum variation of 32.7%.

Table II shows the price variation between 2nd generation cephalosporins. In this group, Cefuroxime (Tab 500 mg) shows maximum price variation of 1696%, while Cefaclor (Tab 250 mg) shows minimum variation of 55%. Table III shows the price variation between 3rd...
generation cephalosporins. In this group, Cefpodoxime (Tab 200mg) shows maximum price variation of 1746%, while Cefdinir (Tab 100mg) shows minimum variation of 8.4%.

**Combination therapy**

In Combination therapy, total 8 combinations were analysed (6-3rd generation and 2-2nd generation combinations). In this, numbers of companies manufacturing a particular drug combination were Tab Cefixime (200mg) + Tab Clavulanate (125mg) - 51 companies, Tab Cefpodoxime (200mg) + Tab Clavulanate (125mg) - 32 companies.

Cefuroxime (250mg) and Clavulanate (125mg) combination shows the maximum variation (320 %) amongst the 2nd generation drugs while Cefixime (200mg) and Ornidazole (200mg) combination shows the maximum variation (9900 %) amongst the 3rd generation drugs. Table IV shows price variation in combination drug therapy.

<table>
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<th>Drugs</th>
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<th>% Price Variation</th>
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<td>4.8</td>
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<th>Max Price per tablet (INR)</th>
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<td>Cap 100</td>
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</tr>
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<td>Tab 200</td>
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<td>81</td>
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<th>Manufacturing companies</th>
<th>Min Price per tablet (INR)</th>
<th>Max Price per tablet (INR)</th>
<th>% Price Variation</th>
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</thead>
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<tr>
<td>Cefuroxime + Clavulanate (125 mg)</td>
<td>2</td>
<td>250</td>
<td>6</td>
<td>16.5</td>
<td>69.3</td>
<td>320</td>
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<td></td>
<td>500</td>
<td>4</td>
<td>30.2</td>
<td>48.0</td>
<td>58.94</td>
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<td>Cefixime + Azithromycin (250 mg)</td>
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<td>200</td>
<td>10</td>
<td>16.0</td>
<td>31.0</td>
<td>93.75</td>
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<td>Cefixime + Clavulanate (125 mg)</td>
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<td>200</td>
<td>51</td>
<td>12.5</td>
<td>63.3</td>
<td>406.4</td>
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<td>Cefixime + Ofloxacin (200 mg)</td>
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<td>200</td>
<td>40</td>
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<td>Cefpodoxime + Ofloxacin (200 mg)</td>
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<td>200</td>
<td>5</td>
<td>19.0</td>
<td>27.0</td>
<td>42.10</td>
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</table>
Relationship between percent price variation and number of manufacturing companies

When we draw a graph showing relationship between manufacturing companies and percent price variation, a peculiar relationship in between these two variables was noted. The number of manufacturing companies showing 0 - 100% price variation were considerably higher than 101-400% price variation range. Beyond this range, there exists a linear relationship. As the number of manufacturing companies increases, the percent price variation also increases (Figure 1).

![Figure 1: Relationship between percent variation and number of manufacturing companies.](image)

**DISCUSSION**

It is evident from our study that there is a wide discrepancy in the price of oral cephalosporins in the Indian market. A varied number of pharmaceutical companies, ranging from 2 companies to 126 companies for a single drug, manufacture these drugs in varied formulations. Ideally, according to the current marketing strategies, as the number of companies manufacturing a particular formulation increases, the number of generic medicines available for the particular drug also increases. Thus, the percent price variation of that formulation should decrease proportionately. Figure 1 shows a peculiar aberration wherein the graph shows a decreasing trend in the initial price variation range and an increasing trend at higher range.

Furthermore, there are ample instances of studies done earlier, which show the wide price variation amongst different formulations of the same drugs. The evident wide variation in the oral anti-diabetic drugs, anti-hypertensives, anti-retrovirals and cephalosporins (antibiotics) has funded an intense debate over the possible reasons for this discrepancy. One of the primary reasons for this price variation is the asymmetry of information or imperfect information amongst practitioners about price of a drug and the resultant expensive treatment. The cost of a drug is a major deciding factor for the patient’s compliance to treatment. In the World Health Organisation (WHO) Guide to good prescribing. “P” stands for personal. It implies that a prescriber is entitled to select drugs on a rational basis, considering the efficacy, safety, suitability and cost of available drugs for a particular condition.

Though a lot is known about efficacy, safety and suitability of drugs, the cost factor is often neglected and ignored. In the absence of knowledge on comparative prices, it is difficult for practitioners to prescribe the most economical treatment. Unaffordable treatment practice add up to the out-of-pocket expenditure. Antimicrobials like cephalosporins are one of the most frequently prescribed drugs with specific dosage schedule and duration. Complete resolution of the disease depends a lot on the patient compliance. The practitioners must be sensitized about the cost of therapy to ensure adequate patient compliance.

Economic goals of the parent company and their targeted returns on the initial investment could lead to a significant rise in the price of the drug. The total average expected cost of developing a new drug would be $ 802 million per new molecular entity. This would include costs of raw supplies, distribution and promotion of drugs, etc. Thus drug development is a high-risk, high-reward game; where the parent company, once the drugs go through, reaps in profits on the initial investment made. Such exuberant pricing should be avoided for the benefit of the general public and the company should undergo a proper study of the existing market structure of the region. Pricing strategies of a pharmaceutical industry shows a definite geographical variation.

There are two main pricing strategies which are in practice at present. First, penetration pricing strategy, wherein price of a new product does not differ from the existing drugs. This is optimal in developed countries where there is greater product substitution.

Skimming pricing strategy is optimal in developing countries where there is limited substitutability of therapeutic drugs. Here, an initial high price for a new drug is set and it is lowered over time, as the product substitution becomes available. Pharmaceutical companies practice this to cover high expenses related to investments and testing, and establish a patent over these branded medicines. To avoid this, generic medicines offer an affordable substitution to the branded medicines.

Generic medicine is a copy of the original branded product, marketed after the expiry date of the patent or other exclusive rights. Hence, they are supposed to be of low cost. It contains the same drug in the same quantity as the brand medicine and are manufactured confirming to international standards. Emphasis should thus be on practising penetration pricing strategy with greater substitution for the branded medicines.

The government should also take proper responsibility to curtail the increasing price variations. Prior to 2005,
branded medicines were manufactured by multinational and large Indian pharmaceutical companies. As a result, the drugs were usually expensive. The Amendment of Indian Patent Act in 2005 resulted in growth of generic pharmaceutical industries thus making drugs available at low cost.  

Strong measures are being taken by the union government and other regulatory bodies to check the doctor-pharmaceutical connection and unethical marketing practices. Through an authoritative decision dated January 21, 2013, Medical Council of India (MCI) has directed principals of medical colleges, directors of hospitals and presidents of all state medical councils that every physician should, rationally, as far as possible, prescribe drugs with generic names. So now, instead of the doctors, pharmaceuticals provide generic medicines to the pharmacies at lower maximum retail prices (MRPs) as decided by the government.  

Also the Drug Price Control Order (DPCO) 2013 has been brought into effect from June 2013. This is an implementation by the National Pharmaceutical Pricing Authority (NPPA) to revise the price of formulations listed under National List of Essential Medicines (NLEM) 2011 to ensure affordability of essential medicines to the common people.  

DPCO 2013 replaces DPCO 1995 which accounted for price regulation of 74 bulk drugs, while DPCO 2013 accounts for almost 628 drugs. This might come as a welcome respite, but many loopholes have been cited in the DPCO 2013. Some of them are:  

- Only drugs on the NLEM will be included where the NLEM itself has been criticized for improper selection of drugs. Thus though certain cephalosporins (Cap Cefalexin 500 mg; Tab Cefixime 100 mg and 200 mg) have been included in the NLEM, others have been excluded. Nevertheless it is clear from our study that Cap Cefalexin 500 mg, Tab Cefixime 100 mg and Tab Cefixime 200 mg show a percent price variation of 69.3%, 410% and 81% respectively.  
- Certain dosages and formulations are not yet included in the DPCO although the parent drug may be included in it. Manufacturers might take undue advantage of this fact and change the dosages and formulations to avoid the DPCO.  
- “Market based pricing” has been used to determine the ceiling price. Wholesalers and retailers have faced a great loss as the margin of profit goes down resulting in lower sales. This has led to shortage of many life-saving medicines in the market.  

The Rashtriya Swasthya Bima Yojana (RSBY), literally “National Health Insurance Programme” has been started by the Government of India in 2008. The objective of this programme is to provide protection to the Below Poverty Line (BPL) households from financial liabilities involving health scares involving hospitalization. Beneficiaries are entitled to hospitalization coverage upto Rs. 30,000 through insurance companies (Ministry of Labour and Employment, 2013). But, it does not cover the outpatient costs and the out-of-pocket expenditure. According to the National Sample Survey (NSS) for the year 1999-2000, in rural India, the share of drugs in the total Out-of-Pocket expenditure (OPP) was estimated to be nearly 83%, while in urban India, it was 77% (NPPP, 2011). Thus the coverage under RSBY is less desirable as many poor still remain uninsured. Another irony is that many villages do not even have hospitals to avail the schemes.  

This remains a major drawback as, if more number of people get insured, their total medical expenses would be looked after by the insurance companies. This would ensure a continuous consumption of medicines by the patients for their treatment. Thus, the pharmaceutical companies, wholesalers, retailers would not undergo major loss and their operating income margin would remain intact.  

A limitation of the study would be that a cost effectiveness study done comparing the amount of drugs purchased by general public having different prices and the resultant effectiveness of the treatment modalities would give a better idea about the pharmaco-economic condition. Also parenteral formulations could be included in the study.  

**CONCLUSION**  

Exuberant pricing adds to the ever increasing economic burden on the general public. Thus the need of the hour is a joint cooperation from practitioners, pharmacists, regulatory authorities and the general public at large to take some action to reduce this price variation while maintaining the therapeutic efficacy. Practitioners must keep in mind the socio-economic background of the patients while prescribing lifesaving drugs like antimicrobials, anticancer drugs, etc.  

Generic medicines must be preferentially prescribed as far as possible to control the expense. The government should make efforts to bring all the people under a standard health insurance programme which is relevant to urban as well as rural populations as a whole. Stringent government orders must be enforced and they should include all the pharmaceutical companies, retailers and wholesalers equally. Such measures will lead to consumers paying lower price for the drugs and increasing the consumption, thereby raising social welfare.  

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**Conflict of interest:** None declared  
**Ethical approval:** The study was approved by the Institutional Ethics Committee
REFERENCES


