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Original Research Article

# Cost variation analysis of parenteral antibiotics in Indian pharmaceutical market

**Prasan R. Bhandari[1]*, Apeksha Bhandary[2]**

[1]Department of Pharmacology, SDM College of Medical Sciences and Hospital, Dharwad, Karnataka, India
[2]Regional Medical Liaison, AstraZeneca, Mumbai, India

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***Correspondence to:**
Dr. Prasan R. Bhandari,
Email: prasangeeta2012@gmail.com



## ABSTRACT

**Background:** The objective of the present study was to analyse price differences between parenteral antibiotics available in a tertiary care teaching hospital.
**Methods:** The study was done in the Department of Pharmacology of S. D. M. College of Medical Sciences, Dharwad, Karnataka. Latest volume of current index of medical specialties or Indian Drug Review was used to analyze the prices of parenteral antibiotics.
**Results:** Overall, prices of 17 single drug antibiotics available in 37 strengths marketed and 8 fixed-dose combinations available in 16 strength marketed were analyzed. It was observed that the maximum cost variation among the single ingredient parenteral antibiotic was with cefpirome 1000 mg. The price difference being Rs. 283 and the cost variation being 90.7%. The minimum price variation was seen with Ampicillin 100 mg of Rs. 4.3 and the cost variation being 40.2%. Additionally the highest price difference was also seen teicoplanin 400 mg i.e., Rs. 610 and its cost variation being 68.5%. Among the fixed-dose combination (FDC's) the maximum price variation was observed in the combination of cefoperazone+sulbactum 1000+1000 of Rs. 340. Whereas the cost variation of the same was 212.5 %. The minimum price variation among the FDC's was of the combination of ceftriaxone 250 mg + tazobactum 31.25 mg Rs. 3.3 and its cost variation being 7.9 %.
**Conclusions:** Pharmacoeconomics facets must be taken into deliberation by healthcare practitioners while prescribing antibiotics to the patients for infectious disease treatment. This will assist compliance, reduce antibiotic resistance and treatment failure.

**Keywords:** Parenteral antibiotics, Pharmacoeconomics, Cost variation, Indian market

## INTRODUCTION

The rapid rise in the cost of drugs all over the world is a serious issue for people belonging to lower economic status which significantly affects the drug compliance.[1]

Medicines are manufactured by various pharmaceutical companies and most of them are sold under different brand names. Competition among the pharmaceutical companies leads to marked variation in the price of some drugs and they promote their branded drugs vigorously. In general, healthy competition in trade always provides a better quality and cost benefits to the consumers. However, these do not apply for patients as they are unaware of the availability of generic drugs and have little choice in the selection of the drugs. Most of the doctors prescribe branded drugs that are costly in place of generic drugs which increase the financial burden on patients.[2,3]

Various studies have shown that therapeutic failure and adherence are influenced by the drug prices.[4-6]

There exist urgent needs to reduce price variation among diverse formulations of drugs available in Indian market, as well as in other countries. Drug pricing control order (DPCO) plays a major role in reducing the price of drugs

manufactured by different pharmaceutical companies in India. The Government of India controls and fixes the prices of certain drugs by bringing these drugs under DPCO and makes it affordable.[7]

India faces the challenge of treating a range of infectious diseases from a milder illness capable of being perceived easily in a simple way to a serious illness such as tuberculosis, malaria, respiratory infection, dengue fever with the potential to cause morbidity and mortality. Availability of life-saving antimicrobials is of paramount importance in all countries afflicted by such virulent diseases. Antibiotics are among the classes of agents most commonly prescribed in almost all the departments of any hospital.[8]

There are various antibiotics available which include penicillin, cephalosporin, fluoroquinolones, aminoglycoside, tetracycline primarily indicated for the prophylaxis, and treatment of bacterial infections caused by both Gram-positive as well as Gram-negative organisms.[9]

Indian markets are flooded with a huge number of antibiotics and the same drugs are marketed under different brands with a marked variation in their prices of the same formulation. In developed countries, where a system of medical insurance is in effect, it may not be a concern, but in developing countries like India, where the medical insurance is only in an emerging stage, affordability to antibiotics becomes a major concern.[10]

Moreover, in the absence of comparative information on antibiotic prices puts the prescribing physicians in a difficult state to select the best drug at the same time most economical treatment regimen.

Indian markets are flooded with a huge number of parenteral antibiotics and the same drugs are sold under different brands which puts the prescribing physicians in a difficult state to choose the best drug for a given patient.

In this context, this price variation of parenteral antibiotics has to be monitored. We hypothesize that by evaluating the variations in the cost of parenteral antibiotics would assist the prescribing physicians in a difficult state to choose the best drug for a given patient thereby increase the rate of complete response and improve long-term outcomes.

Hence, the current study is designed to analyse the price variability pattern among the parenteral antibiotics by calculating the percentage variation of cost.

## METHODS

This open comparative study was done in the Department of Pharmacology of S.D.M. College of Medical Sciences, Dharwad, Karnataka. The study was conducted from January to March 2019 after obtaining the ethical clearance from the Institutional Ethics Committee. Latest volume of current index of medical specialties or Indian Drug Review was used to analyze the prices of parenteral antibiotics.

The cost of a particular parenteral antibiotic drug in the same dose and dosage forms being manufactured by different companies would be compared.

The drugs manufactured by only one company or by different companies, however, in different strengths would be excluded. The difference between the maximum and minimum costs of the same drug manufactured by different pharmaceutical companies would be calculated.

The following formula would be used to calculate the price variation.

Percentage price variation=

$$\frac{Price\ of\ the\ most\ expensive\ brand - Price\ of\ the\ least\ expensive\ brand}{Price\ of\ the\ least\ expensive\ brand} \times 100$$

The cost ratio and ratio of cost of costliest to the cheapest brand of the same generic drug would be estimated.

This gives an estimate, how many times the costliest brand costs more than the cheapest one in each generic group.

### *Statistical analysis*

The findings of our observational study would be expressed as absolute numbers and percentages. Hence there was no need for any separate statistical analysis.

## RESULTS

In this study 17 single drug antibiotics with 37 strengths marketed and 8 fixed dose combination (FDC) with 16 strengths were evaluated. It was observed that the maximum cost variation among the single ingredient parenteral antibiotic was with cefpirome 1000 mg. The price difference being Rs. 283 and the cost variation being 90.7%. The minimum price variation was seen with ampicillin 100 mg of Rs. 4.3 and the cost variation being 40.2%. Additionally the highest price difference was also seen Teicoplanin 400 mg i.e., Rs.610 and its cost variation being 68.5%. Among the FDC's the maximum price variation was observed in the combination of cefoperazone + sulbactum 1000+1000 of Rs. 340. Whereas the cost variation of the same was 212.5%. The minimum price variation among the FDC's was of the combination of ceftriaxone 250 mg+tazobactum 31.25 mg Rs. 3.3 and its cost variation being 7.9 % (Table 1 and 2).

**Table 1: Cost variation single ingredient parenteral antibiotics.**

| Formulation (mg) | Minimum price | Maximum price | Cost ratio= Maximum cost/minimum cost | % Cost variation= difference in maximum and minimum price/minimum price×100 |
|---|---|---|---|---|
| **Aminoglycosides** | | | | |
| **Amikacin** | | | | |
| 100 | 14.9 | 22 | 7.1 | 47.7 |
| 250 | 32.7 | 38 | 5.3 | 16.2 |
| 500 | 58 | 74 | 16 | 27.6 |
| **Netilmicin** | | | | |
| 300 | 325 | 360 | 35 | 10.8 |
| **Beta lactam penicillins** | | | | |
| **Ampicillin** | | | | |
| 100 | 10.7 | 15 | 4.3 | 40.2 |
| 250 | 7.3 | 18.5 | 11.2 | 153.4 |
| 500 | 11.2 | 23 | 11.8 | 105.4 |
| **Piperacillin** | | | | |
| 2000 | 165 | 295 | 130 | 78.8 |
| **Cephalosporins** | | | | |
| **Cefazolin** | | | | |
| 250 | 13.5 | 17.7 | 4.2 | 31.1 |
| 500 | 22.2 | 30 | 7.8 | 35.1 |
| 1000 | 37.4 | 54 | 16.6 | 44.4 |
| **Cefipime** | | | | |
| 500 | 65 | 184 | 119 | 183.1 |
| 1000 | 99.3 | 344 | 244.7 | 246.4 |
| **Cefoperazone** | | | | |
| 1000 | 98 | 301 | 203 | 207.1 |
| **Cefotaxime** | | | | |
| 125 | 10.4 | 16.1 | 5.7 | 54.8 |
| 250 | 13.2 | 80.7 | 67.5 | 511.4 |
| 500 | 21.5 | 60 | 38.5 | 179.1 |
| 1000 | 34.5 | 110 | 75.5 | 218.8 |
| **Cefpirome** | | | | |
| 250 | 88 | 112 | 24 | 27.3 |
| 500 | 195 | 250 | 55 | 28.2 |
| 1000 | 312 | 595 | 283 | 90.7 |
| **Ceftazidime** | | | | |
| 250 | 75 | 118 | 43 | 57.3 |
| 500 | 159 | 193 | 34 | 21.4 |
| 1000 | 250 | 385 | 135 | 54.0 |
| **Ceftizoxime** | | | | |
| 250 | 120 | 120 | 4 | 0.0 |
| 1000 | 316 | 320 | | 1.3 |
| **Ceftriaxone** | | | | |
| 250 | 19 | 49 | 30 | 157.9 |
| 500 | 33 | 179 | 146 | 442.4 |
| 1000 | 47 | 98 | 51 | 108.5 |
| **Cefuroxime** | | | | |
| 750 | 90 | 169 | 79 | 87.8 |
| 1500 | 110 | 222 | 112 | 101.8 |
| **Fluoroquinolones** | | | | |
| **Ciprofloxacin** | | | | |
| 200 mg/100 ml 100 ml pack | 60 | 178 | 118 | 196.7 |

Continued.

| Formulation (mg) | Minimum price | Maximum price | Cost ratio= Maximum cost/minimum cost | % Cost variation= difference in maximum and minimum price/minimum price×100 |
|---|---|---|---|---|
| **Ofloxacin** | | | | |
| 200 mg per 100 ml pack | 38 | 92.7 | 54.7 | 143.9 |
| **Glycopeptides** | | | | |
| **Teicoplanin** | | | | |
| 200 | 540 | 810 | 270 | 50.0 |
| 400 | 890 | 1500 | 610 | 68.5 |
| **Vancomycin** | | | | |
| 500 | 275 | 390 | 115 | 41.8 |
| 1000 | 683 | 750 | 67 | 9.8 |

**Table 2: Cost variation of parenteral antibiotics as FDC's.**

| Formulation (mg) | Minimum price | Maximum price | Cost ratio= Maximum cost/minimum cost | % Cost variation= difference in maximum and minimum price/minimum price×100 |
|---|---|---|---|---|
| **FDC of parenteral antibiotics** | | | | |
| **Amoxycillin+clavulanic acid** | | | | |
| 1000+200 | 120 | 199 | 79 | 65.8 |
| **Ampicillin+sulbactum** | | | | |
| 1000+500 | 47 | 110 | 63 | 134.0 |
| **Cefipime+tazobactum** | | | | |
| 1000+125 | 172 | 280 | 108 | 62.8 |
| **Cefoperazone+sulbactum** | | | | |
| 500+500 | 110 | 210 | 100 | 90.9 |
| 1000+1000 | 160 | 500 | 340 | 212.5 |
| **Ceftazidime+tazobactum** | | | | |
| 250+31.25 | 109 | 235 | 126 | 115.6 |
| 1000+125 | 290 | 325 | 35 | 12.1 |
| **Ceftriaxone+sulbactum** | | | | |
| 250+125 | 35 | 54 | 19 | 54.3 |
| 500+250 | 65 | 76 | 11 | 16.9 |
| 1000+500 | 98 | 140 | 42 | 42.9 |
| **Ceftriaxone+tazobactum** | | | | |
| 250+31.25 | 41.7 | 45 | 3.3 | 7.9 |
| 500+62.5 | 71 | 95 | 24 | 33.8 |
| 1000+125 | 132 | 170 | 38 | 28.8 |
| **Piperacillin+tazobactum** | | | | |
| 1000+125 | 85 | 180 | 95 | 111.8 |
| 4000+500 | 199 | 968 | 769 | 386.4 |

## DISCUSSION

It is apparent from this evaluation that there is an extensive divergence in the cost of parenteral antibiotics in the Indian market. Additionally, more than one company retails a drug under diverse brand names which could cause the condition of bigger price variation among drugs marketed. The studies conducted previously on antidiabetics, antihypertensive's, antiretrovirals and peptic ulcer drugs presented the extensive cost differences between various brands comprising the same components.[11-13] While a lot is acknowledged about the efficacy, safety and suitability of drugs, the price aspect is frequently ignored and disregarded.

Antibiotics are the class of agents which are very commonly prescribed for the treatment and prophylaxis of various infectious diseases. The complete resolution of the disease depends a lot on the patient compliance. Higher medication costs are often being considered as an important factor for medication non-adherence, dropouts/lost follow-ups and drug resistance. Hence, the practitioner must be sensitized about the cost of therapy to make sure adequate patient compliance.[14]

In this study 17 single drug antibiotics with 37 strengths marketed and 8 FDC with 16 strengths were evaluated. It was observed that the maximum cost variation among the single ingredient parenteral antibiotic was with cefpirome

1000 mg. The price difference being Rs. 283 and the cost variation being 90.7%. The minimum price variation was seen with ampicillin 100 mg of Rs. 4.3 and the cost variation being 40.2%. Additionally the highest price difference was also seen teicoplanin 400 mg i.e., Rs. 610 and its cost variation being 68.5 %. Among the FDC's the maximum price variation was observed in the combination of cefoperazone 1000 and sulbactum 1000 of Rs. 340. Whereas the cost variation of the same was 212.5%. The minimum price variation among the FDC's was of the combination of ceftriaxone 250 mg with tazobactum 31.25 mg Rs. 3.3 and its cost variation being 7.9%.

Shankar et al demonstrated the mean percentage price variation for antibiotics was considered to be 38.1%, and the evaluation conducted by Patel et al in India revealed a cost variation for oral antibiotics was approximately 93%.[15,16] The cause for the same could be that India is a large country as regards its population and geographically with robust developed industry and the absolute number of players. Although a vast number of manufacturing establishments benefit in reducing the cost of medicines owing to competition, there is a propensity between pharmaceutical businesses of endorsing an impression that the products rated higher are superior than their inexpensive equivalents, which are not factual. Therefore, a healthy apparatus to govern price variation among brands could be put in practice in bringing down and regulating the cost of branded drugs.

In a study conducted by Rataboli et al were a database of drugs marketed in India was used to find the percentage price variation from the average of marketed antibiotics.[17] Three drugs fell in 0-25% and 25.1-50% range group. Five drugs fell each in 50.1-75 and 75.1-100% while 11 drugs were having more than 100% price variations. In comparison with this study, our study reported a high price variation pattern. This might be attributed to the systems of pharmacy and therapeutic committee which has control over the selection of drugs as most of the hospitals analyse cost comparison of brands before entry into the hospital formulary. This might serve to control price variation to some extent.

In another study conducted by Shareef et al among the single drug parenteral antibiotics, extreme percentage price variation and highest cost ratio between brands of same drugs was found in the case of amoxicillin 250 mg (270.43%) with cost ratio (1:3.7) and minimum in the case of ceftazidime 2000 mg (5.26%) with cost ratio (1:1.05).[18] In the case of fixed-dose combinations of parenteral antibiotics, cefoperazone 500 mg+sulbactam 500 mg combination showed the highest cost ratio (1:4.20) and percentage price variation (320.84) and the lowest cost ratio (1:1.11) and percentage price variation (11.44) was found to be for amoxicillin 300 mg and clavulanate 600 mg combination.

Therefore, it is imperative that serious methods are essential be taken by the administration to generate the consistency in the cost by executing a facility of drug manual of comparative prices to the prescribers that would ensure cost-effective treatment to the patients.

Additional studies are required to support our evaluation by exploring the explanations for the augmented cost disparity between the branded drugs fathom an actual technique to avoid this development that would go a long way in justifying the pharmacoeconomics facets of antibiotics in the infectious disease treatment.

## CONCLUSION

The study stresses that the cost disparity of various brands of the equivalent drug obtainable in the hospital formulary is very extensive. Pharmacoeconomics features must be considered by during prescribing antibiotics to the patients for infectious disease treatment. As a consequence there would a reduction in antibiotic resistance, non-adherence and treatment failure. Systematic cost assessment of drugs with diverse brands offered in the market at the hospital level experts and concerned boards before including in the hospital formulary would be a model situation and could be extremely beneficial to patients with low socioeconomic background.

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