



## Research Article

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## PHARMACOECONOMIC ANALYSIS OF ORAL AND INJECTABLE PROTON PUMP INHIBITORS AVAILABLE IN INDIA

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### Keywords

*PPI, Cost ratio, Percentage cost variation*

### ABSTRACT

**Introduction:** Proton pump inhibitors (PPIs) effectively suppress acid secretion and play an important role a lot of gastrointestinal disorders. PPIs are generally used long term by the patients. This can cause an increase in patient cost and subsequent decrease in adherence to the prescription. Hence, this study was done to assess the cost variation of PPIs. **Methods:** The cost of different brands of commonly used PPIs (10 capsules/tablets for oral drugs and one ampoule/vial for injectable drugs) was tabulated by referring to the “Monthly Index of Medical Specialties” October – December 2021, and 1mg online pharmacy. The cost ratio and percentage cost variation for various brands of a particular strength and dosage form was calculated and compared. Cost ratio >2 and cost variation >100% was considered significant. **Results:** The results showed a huge variation in costs of different brands with the highest being Rabeprazole 20mg (Cost ratio-16.4, Percentage cost variation-1540%) in oral formulation and Rabeprazole 20mg (11.9, 1090%) in the injectable formulation. Among oral drugs, Omeprazole 40mg has the lowest cost ratio and percentage cost variation (1.60, 60.34%) and Pantoprazole 40mg (1.51, 51.16%) in case of injectable formulations. **Conclusion:** There is a wide variation in the prices of PPIs available in the market. Huge demand for the commonly orally prescribed drugs like Omeprazole 20mg and Pantoprazole 40mg could be the reason for the high cost. Among injectable preparations, Pantoprazole 40mg is the most commonly prescribed but it has an acceptable cost ratio which is a positive sign.

### INTRODUCTION

Since the introduction of the first proton pump inhibitor (PPIs) in 1989, this class of medications has become a staple in the management of GIT disorders such as peptic ulcer, gastroesophageal reflux disease, gastritis, oesophagitis,

Zollinger Ellison’s syndrome risk reduction of gastric ulcer associated with non-steroidal anti-inflammatory drugs (NSAIDs) and H. pylori eradication to reduce the risk of duodenal ulcer recurrence in combination with antibiotics. For most of these indications, the recommended maximum duration

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of therapy is 4 to 8 weeks [1]. PPIs are also used as protectant agent in stress ulcer disease and along with the use of NSAID [2]. Inevitable changes in lifestyle and food habits of Indian population due to rapid urbanization along with excessive use of various medications are the reasons for excessive gastric acid secretion [3,4]. The increased gastric acid secretion destructs mucosal lining of gastrointestinal tract leading to ulceration, erosive esophagitis, erosive gastritis and gastro oesophageal reflux disease (GERD) etc. [5].

PPIs are potent agents that significantly reduce acid secretion by irreversibly binding to  $H^+/K^+$  adenosine triphosphatase, or the proton pump, located in the parietal cells [6]. All PPIs have been found to have equivalent efficacy at comparable doses [7]. Although similar to each other in terms of efficacy and safety, PPIs have important differences in their costs. Overall, these medications have among the highest sales and hold a huge share in the overall drug market. In a report published by Technavio, the PPI market is showing an incremental growth of \$3.45B and is estimated to reach a value of \$10.24B by 2026.

Pharmacoeconomics plays an important role in practice of medicine in developing countries. Cost of drugs is an important factor influencing compliance with treatment of disease and also constitutes an essential part of rational drug prescription. Pharmaceutical Industry has many branded formulation of the same drug with large difference in selling price. In India, most of the drugs are available in brands and these are also prescribed by clinician mostly by brand name.

This may affect the patient's finance adversely if costly brand is prescribed specially in gastrointestinal disorders which need treatment for longer duration [8,9]. Studies conducted in past show a wide variation in cost of drugs of different brands. Therefore, we decided to carry out the study which compares the cost of different brands of PPIs both oral and injectables used for the treatment of gastrointestinal disorders. There have been very few studies that have compared the prices in the recent market. So, it is important to conduct this study to get information about the present scenario.

## METHODOLOGY

It is a cross-sectional, observational study. Cost of a particular PPI drug in the same strength and dosage forms being manufactured by different companies was obtained from latest

“Monthly Index of Medical Specialities (October – December 2021), and 1mg online pharmacy as they are readily available source of drug information and are updated regularly. After going through all relevant online pharmacies, we found 1mg to have information about maximum number of brands and so we continued with that platform. Ethical approval for this study was not required as all the information we took is freely available on the public domain.

Steps for this study:

1. For this study, we searched for all the brand names of a specific PPI drug of a particular strength and dosage form.
2. Then we checked the number of brands available on the website and MIMS.
3. The cost of 10 tablets/capsules and that of one ampoule /vial was taken for our study.
4. We tabulated the number of brands along with the minimum and the maximum cost that we found by sorting the data on the website.
5. The cost of injectable drugs and oral drugs in forms of tablet and capsule has been tabulated separately.
6. Cost ratio between the maximum and minimum cost of the same drug manufactured by different pharmaceutical companies was calculated as follows:

$$\text{Cost ratio} = \frac{\text{Maximum cost}}{\text{Minimum cost}}$$

7. Percentage cost variation was calculated as follows:

$$\begin{aligned} \text{\%cost variation} \\ = \frac{\text{Maximum cost} - \text{Minimum cost}}{\text{Minimum cost}} \times 100 \end{aligned}$$

## Inclusion criteria

- Drugs only belonging to group of proton pump inhibitors (oral and parenteral).
- Dosage form of oral PPI drugs was only capsule or tablet.
- Drugs only belonging to branded manufacturing companies.

## Exclusion criteria

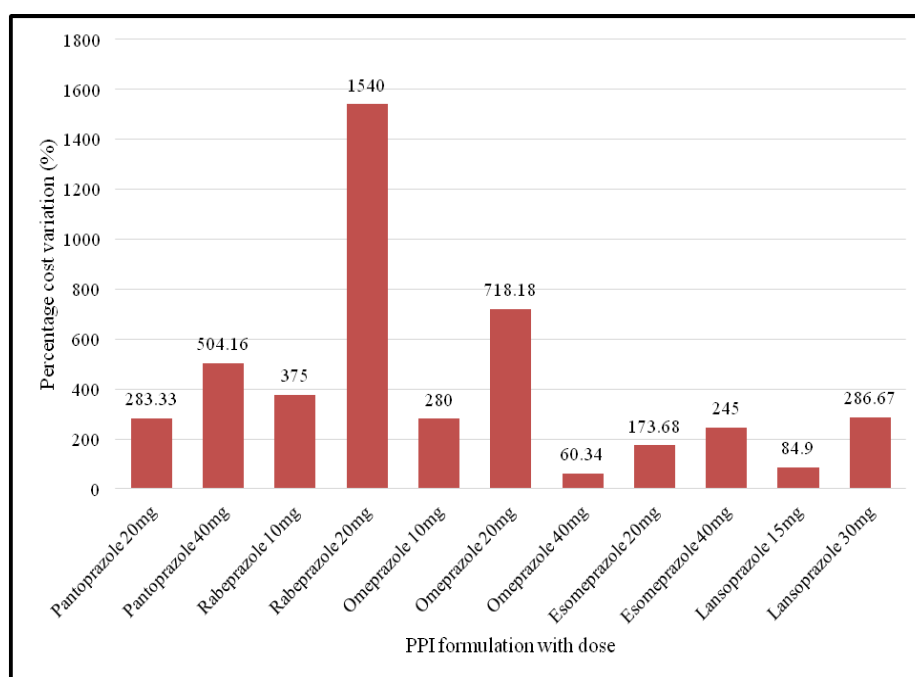
- Fixed dose combination of PPI drugs.
- PPI drugs available in liquid dosage forms like syrups.

## RESULTS

Table 1 shows the number of manufacturing companies, minimum and maximum cost, cost ratio and percentage cost variation of the oral PPIs of different composition and strengths.

**Table 1: Maximum and Minimum cost, Cost ratio and Percentage cost variation of oral Proton Pump Inhibitors**

Drug	Formulations	Doses	Manufacturing companies	Min cost (Rs.)	Max cost (Rs.)	Cost ratio	Percentage cost variation (%)
Tab/cap Pantoprazole	2	20 mg	49	30	115	3.83	283.33
Tab/cap Pantoprazole		40 mg	467	24	145	6.04	504.16
Tab/cap Rabeprazole	2	10 mg	48	24	114	4.75	375
Tab/cap Rabeprazole		20 mg	325	10	164	16.4	1540
Tab/cap Omeprazole	3	10 mg	23	10	38	3.8	280
Tab/cap Omeprazole		20 mg	354	11	90	8.1	718.18
Tab/cap Omeprazole		40 mg	22	58	93	1.60	60.34
Tab/cap Esomeprazole	2	20 mg	29	38	104	2.73	173.68
Tab/cap Esomeprazole		40 mg	32	20	69	3.45	245
Tab/cap Lansoprazole	2	15 mg	28	53	98	1.84	84.90
Tab/cap Lansoprazole		30 mg	62	45	174	3.86	286.66

**Figure 1: Graphical representation of the percentage cost variation of oral Proton Pump Inhibitors**

Similarly Table no. 02 shows the number of manufacturing companies, minimum and maximum cost, cost ratio and percentage cost variation of the injectable PPIs of different composition and strengths.

**Table 2: Maximum and Minimum cost, Cost ratio and Percentage cost variation of injectable Proton Pump Inhibitors**

Drug	Formulations	Doses	Manufacturing companies	Min cost (Rs)	Max cost (Rs)	Cost ratio	Percentage cost variation (%)
Rabeprazole	02	IV 20 mg	36	22	262	11.90	1090.90
Rabeprazole		IV 40 mg	01	110	---	---	-----
Pantoprazole	02	IV 20 mg	05	45	119	2.64	164.44
Pantoprazole		IV 40 mg	213	43	65	1.51	51.16
Omeprazole	01	IV 40 mg	13	19	85	4.47	347.36
Esomeprazole	01	IV 40 mg	08	60	190	3.16	216.66

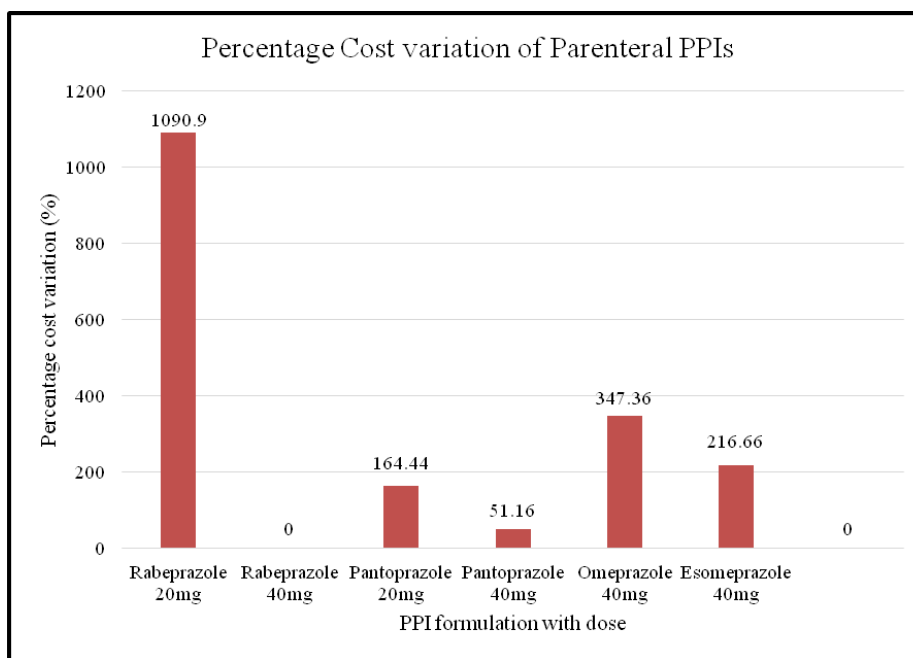


Figure 2: Graphically shows the percentage cost variation of parenteral Proton Pump Inhibitors. Only one brand is available for i.v. Rabeprazole 40 mg; hence cost-range and cost-ratio cannot be calculated. The percentage cost ratio is 0% for the same as shown in the graph

Among the 1439 brands of various oral PPIs available in India, Pantoprazole has highest numbers of brands i.e. 516 (35.85%) brands, omeprazole has total 399 (27.72 %) brands, rabeprazole has 373 (25.92%) brands, lansoprazole has 90 (6.25%) brands and Esmoprazole has only 32 (2.22%) brands in the market.

Among the 276 brands of various Parenteral PPIs available in India, Pantoprazole has highest numbers of brands i.e. 218 (78.98%) brands, rabeprazole has 37 (13.40%) brands, omeprazole has 13 (4.71 %) brands and Esmoprazole has only 08 (2.89%) brands in the market.

We should prescribe those drugs who bears lowest cost ratio and lowest percentage cost variation. So, ideally based on the data physicians should prescribe tablet/capsule Omeprazole (40 mg) and Lansoprazole (15mg) amongst all the drugs that are mentioned in Table 1 and Pantoprazole 40mg amongst injectable formulations as shown in Table 2.

## DISCUSSION

Healthcare community is ever more sensitive to costs, as the overall health expenditures are escalating. Accordingly, appraisal of goods and services in healthcare goes beyond evaluation of safety and efficacy in which the economic impact of these goods and services on the cost of healthcare is also

considered. As in Pharmacoeconomics, efficiency is the key concept and this principle helps one to design strategies for buying the greatest amount of benefits for a given resource use [10].

Our study showed a very high fluctuation in the minimum and maximum price of Proton pump inhibitors, maximum variation was seen with capsule Rabeprazole 20 mg, i.v. Rabeprazole 20mg and minimum within capsule Omeprazole 40 mg, i.v. Pantoprazole 40mg. The cost ratio was also observed to be very high. The prices of most of the PPIs brands have percentage price variation above 100% and cost ratio more than 2, which is not an acceptable situation for patients. Of the 9 drugs studied, most of which are commonly prescribed, percentage price variation is very wide leading to unfair burden on the consumer. Capsule Rabeprazole 20mg shows minimum cost as Rs. 10 and maximum cost being Rs. 164 with percentage cost variation being 1540%. Rabeprazole is claimed to have faster onset of action as compared to other PPIs. This could be the reason for having many manufacturing companies (325) with wide price variation.

The highest no. of manufacturing companies was 467 with capsule pantoprazole 40mg with cost ratio being 6.04 and percentage cost variation being 504.16%. Pantoprazole 40mg is

one of the most commonly prescribed drug has much better comparisons with Rabeprazole 20mg with respect to cost ratio and percentage cost variation.

The minimum and the maximum cost of tablet/capsule omeprazole 20mg is shown in table 1. The cost ratio for the same is 18.1 and percentage of cost variation is 718%. Comparing this with a research done in India by Bargade MB et. al. [11], where cost ratio was 26.25 and percentage of cost variation was 2525%. This is very high in contrast to the values from our study. The brands of capsule omeprazole 20mg were 354 in comparison to 229 from Bargade MB et al. [11]. The trends show that since the manufacturing companies increased, this could be a reason for decreased cost ratio and price variation.

A study by Bate CM et. al. states that omeprazole 40mg does not provide additional benefit over 20mg [12]. Our study found lesser brands for omeprazole in 40mg category. Omeprazole 40mg has lesser price variation (minimum cost: Rs. 58, maximum cost: Rs. 93) to achieve percentage cost variation of 60.34%. Since the price variation assumes significance when the cost ratio exceeds 2 and percentage cost variation exceeds 100%, Omeprazole 40mg presents an ideal scenario.

Ironically, uncommonly used Omeprazole 40mg represents ideal price variation. In contrast, one of the most commonly used PPI Rabeprazole 20mg with almost 325 manufacturing companies showed huge price variation with highest percentage cost variation [13].

We also compared the cost variations amongst the parenteral PPIs, Rabeprazole 20mg shows a high cost ratio of 11.9 with a very high percentage cost variation of 1090%. Pantoprazole 40mg represents ideal price variation with cost ratio of 1.51 with a percentage cost variation of 51.16%.

This is similar to the results obtained with the oral PPIs. Pantoprazole 40mg is one of the most widely used parenteral PPIs with large number of manufacturing companies (213) and it shows minimum price variation. Therefore, both injectable and oral Pantoprazole 40mg depicts good price variation. This is in contrast with injectable Rabeprazole with 36 manufacturing companies showing a huge price variation. Thus, this study showed both oral and injectable Rabeprazole showed a huge cost variation.

We have included only those brands of PPIs which are mentioned in the MIMS India and 1mg online pharmacy. Therefore, few brands might have been missed which are not mentioned above. Also, various fixed dose combinations (FDC) of these PPIs with many other drugs were not taken into consideration while doing this study.

A decrease in drug expenditure can be achieved by changing PPIs prescribing practices. As all PPIs are equally effective, cost of treatment can be easily lowered without compromising clinical efficacy. This will be helpful in increasing the compliance of the patient to any drug therapy.

### **CONCLUSION**

Our study showed that the percentage price variation of different brands of the same oral PPIs manufactured in India is very wide as expected. Substantial movement towards use of generics may lower down the cost variation and thus reducing the economic burden on the patient.

### **FINANCIAL ASSISTANCE**

Nil

### **CONFLICT OF INTEREST**

The authors declare no conflict of interest

### **AUTHOR CONTRIBUTION**

Pradnya Deolekar conceptualized and came up with the study design with the methodology. Kavitha Vivek Dongerkery was involved in validation of the concept and design of the study, collection of data, and writing the first draft of the article. Pramila Yadav was involved in data curation, analysis and reviewing and editing the draft. Jyoti Sonawane supervised the project, helped in data curation and analysis. Azra Naseem was involved in data curation and analysis along with reviewing and editing of the article. All authors read and approved the final manuscript.

### **REFERENCES**

- [1] Atkins AM, Chandra Sekar RM. Proton pump inhibitors: their misuse, overuse, and abuse. *IOSR J Pharm.* **3(2)**, 25-9 (2013).
- [2] Sachs G, Shin, Moo J, Olga V, Lambrecht N, Iskandar Y, Munson K. The Gastric H, K ATPase as a Drug Target. *J CliGastroenterol.* **41(2)**, 226-42 (2007).

- [3] Moore M, Gould P, Keary BS. Global urbanization and impact on health. *Int J Hyg Environ Health*. **206(4-5)**, 269-78 (2003).
- [4] Ibrahim H, Awadalla. Health effect of slums: A consequence of urbanization. *Serbian Journal of Management*. **3**, 7-14 (2013).
- [5] Mohammed KM, Suman C, Bogadi V, Prabhakar B, Rao KPR, Devi S, Vasavi M. Epidemic trends of upper gastrointestinal tract abnormalities: hospital-based study on endoscopic data evaluation. *Asian Pac J Cancer Prev*. **16(14)**, 5741-7 (2015).
- [6] Forte JG, Lee HC. "Gastric adenosine triphosphatases: A review of their possible role in HCl secretion". *Gastroenterol*. **73(4 Pt 2)**, 921- 6 (1977).
- [7] Das SC, Mandal M, Mandal SC. A critical study on availability and price variation between different brands: Impact on access to medicines. *Indian J Pharm Sci*. **69(1)**, 160-3 (2007).
- [8] Barkun A, Leontiadis G. Systematic review of the symptom burden, quality of life impairment and costs associated with peptic ulcer disease. *Am J Med*. **123(4)**, 358-66 (2010).
- [9] Bhushan R, Kishore A, Chandra A, Kumar A, Singh HK. Study of the price variation analysis of proton pump inhibitors [PPI] available in Indian pharmaceutical market. *Int J Res Med Sci*. **9**, 226-9 (2021)
- [10] Shankar PR, Subish P, Mishra P, Lalit M. Ambiguous pricing of Nepalese medicines. *J Inst Med*. **28(3)**, 35-8 (2006).
- [11] Bargade MB, Mahatme MS, Hiware S, Admane PD. Cost-minimization analysis of proton pump inhibitors in India. *Int J Basic ClinPharmacol*. **5**, 1043-7 (2016).
- [12] Bate CM, Booth SN, Crowe JP, Hepworth-Jones B, Taylor MD, Richardson PD. Does 40 mg omeprazole daily offer additional benefit over 20 mg daily in patients requiring more than 4 weeks of treatment for symptomatic reflux oesophagitis? *Aliment Pharmacol Ther*. **7(5)**, 501-507 (1993).
- [13] Robinson M. New-generation proton pump inhibitors: overcoming the limitations of early-generation agents. *Eur J Gastroenterol Hepatol*. **13** Suppl 1:S43-S47. (2001)