



# Pharmacoeconomic analysis of Oral & Injectable Proton Pump Inhibitors available in India



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## ABSTRACT

**Introduction:** Proton pump inhibitors (PPIs) effectively suppress acid secretion and play an essential role in peptic ulcer disease and gastroesophageal reflux disease. There is a genuine concern about overutilizing PPIs, leading to significantly high costs and undesirable outcomes. An increase in the patient medication cost was associated with decreased adherence to prescription medication. Hence, this study assessed the cost variation of proton pump inhibitors (PPI) drugs.

**Methods:** The cost of different brands of commonly used PPIs was sorted out by referring latest “Monthly Index of Medical Specialties” October – December 2021, and 1mg online pharmacy. The cost of 10 dosage forms (Tablets/capsules) in INR of each brand, Cost Ratio, and Percentage Cost Variation for individual drug brands was calculated in the case of an oral drug, and the cost of one vial or ampoule was noted in the case of injectable drug. At last, the cost ratio and percentage cost variation of various brands was compared.

**Results:** The data analysis showed a significant variation in the costs of different brands of proton pump inhibitors available in the Indian market. Percentage variation in cost for oral preparations of proton pump inhibitors marketed in India was found to be tablet/capsule Rabeprazole 20mg (1540%), Omeprazole 20 mg(718.18%), Pantoprazole 40mg (504.16%), Esomeprazole 20mg (173.68%), Lansoprazole 15 mg (84.90 %), Omeprazole 40 mg (60.34%) and with injectable preparations IVR abeprazole 20mg (1090.90%), Omeprazole 40 mg (347.36%), Esomeprazole 40mg (216.66%), Pantoprazole 20mg (164.44 %), Pantoprazole 40mg (51.16%).

**Conclusion:** There is a wide variation in the prices of proton pump inhibitors available in the market. Regulatory authorities, pharma companies, and physicians should maximize their efforts to reduce the cost of drugs. The need to search for reliable process indicators for the effectiveness of anti-diabetic therapy has been expressed in the literature. Process indicators have been described as essential processes that contribute to achieving outcomes



## Introduction

Since the introduction of the first proton pump inhibitor (PPI) 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 (DU) recurrence in combination with antibiotics. For most of these indications, the recommended maximum duration of therapy is 4 to 8 weeks [1].

Proton pump inhibitors (PPIs) effectively suppress acid secretion and play an essential role in peptic ulcer disease and gastroesophageal reflux disease. PPIs are also used as protectant agents in stress ulcer disease and along with the use of NSAIDs [2].

Inevitable changes in lifestyle and food habits of the 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 the 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<sup>+</sup>/K<sup>+</sup> adenosine triphosphates, or the proton pump, located in the parietal cells [6]. These are the mainstay of treatment in gastric and duodenal ulcers, GERD, erosive esophagitis, self-treatment of heartburn, pathological hypersecretory conditions like Zollinger-Ellison syndrome, prevention and treatment of non-steroidal anti-inflammatory drugs (NSAIDs) associated gastric ulcers. Also, the risk of duodenal ulcer recurrence associated with H. pylori infection is reduced. All PPIs have been found to have equivalent efficacy at comparable doses. [7] Although similar in terms of efficacy and safety, PPIs have essential cost differences. Overall, these medications have among the highest sales levels. The proton pump inhibitors market was valued at USD 2,750 million in 2020 and is anticipated to reach USD 3,585 million in 2026.

Pharmacoeconomics plays a vital role in the practice of medicine in developing countries. The cost of drugs is an important factor influencing compliance with the treatment of disease and also constitutes an essential part of rational drug prescription. The pharmaceutical industry has many branded formulations of the

same drug with significant selling price differences. In India, most drugs are available in brands, which clinicians, mostly in brand name, also prescribe. This may affect the patient's finance adversely if the costly brand is prescribed, especially in GIT disorders that need treatment for a longer duration. [8, 9]. Studies conducted in the past show a wide variation in the cost of drugs of different brands. Therefore, we decided to carry out a study that compares the cost of different brands of PPIs, both oral and injectables, used to treat GIT disorders. The study focuses on the cost-effectiveness analysis of different available brands of proton pump inhibitors in India.

## Method

The cost of a particular PPI drug in the same strength and dosage forms manufactured by different companies was obtained from the latest "Monthly Index of Medical Specialities October – December 21 and 1mg online pharmacy as they are a readily available source of drug information and are updated regularly. The cost of injectable drugs and oral drugs in forms of table and capsule should be calculated separately.

1. The cost of 10 tablets/capsules and one ampoule /vial was calculated.
2. Difference between the maximum and minimum cost of the same drug manufactured by different pharmaceutical companies was calculated.
3. Cost ratio between the maximum and minimum cost of the same drug manufactured by different pharmaceutical companies was calculated as follows:
4. Cost ratio = Maximum cost / Minimum cost
5. Percentage cost variation <sup>8</sup> was calculated as follows:

$$\% \text{cost variation} = \frac{\text{Maximum cost} - \text{Minimum cost} \times 100}{\text{Minimum cost}} \quad [10]$$

## Inclusion criteria

- Drugs belonging to the group of proton pump inhibitors only should be included.
- Dosage form of PPI Drugs will be only capsules or tablets.
- Drugs belonging to branded manufacturing companies should be included.
- Drugs belonging to the same strength should be included.

## Exclusion criteria

- PPI drugs in combination with other drugs as prokinetic drugs are excluded.

- PPI Drugs available in doses form of syrup are excluded.
- Table 1: Drug cost, Cost ratio and percentage cost variation of commonly used Oral Proton Pump Inhibitors available in India

## Results

Among the 1439 brands of various oral PPIs available in India, Pantoprazole has the highest number of brands, i.e., 516 (35.85%) brands, omeprazole has a total of 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 the highest number 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.

**Table 1:** The data analysis showed a significant variation in the costs of different brands of proton pump inhibitors available in the Indian market. Percentage variation in cost for oral preparations of proton pump inhibitors marketed in India was found to be tablet/capsule Rabeprazole 20mg (1540%), Omeprazole (20 mg) 718.18%, Pantoprazole 40mg (504.16%), Rabeprazole 10mg (375%), Lansoprazole 30 mg (286.66%), Pantoprazole 20mg (283.33%), Omeprazole 10mg (280 %), Esomeprazole 40mg (245%), Esomeprazole 20mg (173.68%), Lansoprazole 15 mg (84.90 %), Omeprazole 40 mg (60.34%).

Cap Rabeprazole (20 mg) shows the highest cost ratio and percentage cost variation at 16.4 and 1540, while Capsule Omeprazole 40 mg shows the lowest cost ratio and percentage cost variation of 1.60 and 60.34, respectively.

**Table 2:** Percentage variation in cost for injectable preparations of proton pump inhibitors marketed in India was found to be with IV Rabeprazole 20mg (1090.90%), Omeprazole 40 mg (347.36%), Esomeprazole 20mg (216.66%), Pantoprazole 20mg (164.44 %), Pantoprazole 40mg (51.16%).

IV Rabeprazole (20 mg) shows the highest cost ratio and percentage cost variation as 11.90 and 1090, while Pantoprazole 40 mg shows the lowest cost ratio and percentage cost variation as 1.51 and 51.16.

Only one price is available iv Rabeprazole 40 mg; hence cost range and cost ratio cannot be calculated.

We should prescribe drugs with the lowest cost ratio and percentage cost variation. So we should prescribe tab/ cap Omeprazole (40 mg) and Lansoprazole (15mg) among all drugs mentioned in Table 1, and amongst the injectable preparations, Pantoprazole 40mg.

## Discussion

The healthcare community is increasingly sensitive to costs as overall health expenditures are escalating. Accordingly, appraisal of goods and services in healthcare goes beyond evaluating safety and efficacy, in which the economic impact of these goods and services on the cost of healthcare is also considered. As in economics, efficiency is a crucial concept in pharmacoeconomics, and this principle helps one design strategies for buying the most significant benefits for a given resource use.[8]

Our study showed a very high fluctuation in the minimum and maximum price of Proton pump inhibitors; maximum variation was seen with cap Rabeprazole 20 mg, iv Rabeprazole 20mg, and minimum with cap Omeprazole 40 mg, iv Pantoprazole 40mg. The cost ratio was also observed to be very high. Most PPI brands have a percentage price variation above 100%, which could be a better situation for patients. Of the 09 drugs studied, most commonly prescribed, the percentage price variation is extensive, leading to an unfair burden on the consumer.

Rabeprazole 20mg shows a minimum cost of 10 and a maximum cost of 164, with a percentage cost variation of 1540. Rabeprazole is claimed to have a faster onset of action than other PPIs. This could be why many manufacturing companies (325) have wide price variations.

The highest number of manufacturing companies was 467, with pantoprazole 40, with a cost ratio of 6.04 and a percentage cost variation of 504.16. Pantoprazole 40 is one of the most commonly prescribed drugs and compares much better with Rabeprazole 20 concerning cost ratio and percentage cost variation.

The minimum and maximum cost of tab/cap omeprazole is 20mg, as shown in Table 1. The cost ratio is 18.1, and the percentage of cost variation is 718. Comparing this to an article by Bargade MB et al. [11], where the cost ratio was 26.25, and the percentage of cost variation was 2525. This is very high in contrast to the values from our study. The brands of omeprazole 20mg



were 354 compared to 229 from Bargade MB et al. [11]. The trends show that the increased manufacturing companies could be a reason for decreased cost ratio and price variation.

Many literature studies Bate, C M et al. [12] quote that omeprazole 40mg does not provide additional benefit over 20mg. Our study found lesser brands for omeprazole 40. Omeprazole 40 has a lesser price variation (min: 58, max: 93) to achieve a percentage cost variation of 60.34. Since the price variation assumes significance when the cost ratio exceeds 2, and the percentage cost variation exceeds 100, Omeprazole 40 presents an ideal scenario.

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

We also compared the cost variations amongst the parenteral PPIs; Rabeprazole 20 shows a high-cost ratio of 11.9 with a very high percentage cost variation of 1090. Pantoprazole 40 represents an ideal price variation with a cost ratio of 1.51 with a percentage cost variation of 51.60. This is similar to the results obtained with the oral PPIs. Pantoprazole 40 is one of the most widely used parenteral PPIs with many manufacturing companies (213) and shows minimum price variation. Therefore, both injectable and oral Pantoprazole 40 depicts good price variation. This contrasts with injectable Rabeprazole, with manufacturing companies 36 showing a considerable price variation. Thus, this study showed that both oral and injectable Rabeprazole had a considerable cost variation.

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

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

## Conclusion

Our study showed that the average percentage price variation of different brands of the same oral PPIs manufactured in India is extensive, as expected. The substantial movement towards generics may lower the cost variation and thus reduce the economic burden on the patient. Both injectable and oral Pantoprazole showed minimum cost variation.

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## Ethical Considerations

There were no ethical considerations to be considered in this research.

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## Conflict of interest

All authors declare no potential conflicts of interest in conducting the study and publishing the article.

## Tables

Table 1. Drug cost, Cost ratio and percentage cost variation of commonly used Oral Proton Pump Inhibitors available in India

Drug	Formulations	Doses	Manufacturing companies	Min cost (Rs)	Max cost (Rs)	Cost ratio	% cost variation
<b>Oral preparations</b>							
Tab/cap Pantoprazole	2	20 mg	49	30	115	3.83	283.33
Tab/cap Pantoprazole		40mg	467	24	145	6.04	504.16
Tab/cap Rabeprazole	2	10mg	48	24	114	4.75	375
Tab/cap Rabeprazole		20 mg	325	10	164	16.4	1540
Tab/cap Omeprazole	3	10mg	23	10	38	3.8	280
Tab/cap Omeprazole		20 mg	354	11	90	18.1	718.18
Tab/cap Omeprazole		40mg	22	58	93	1.60	60.34
Tab/cap Esomeprazole	2	20 mg	29	38	104	2.73	173.68
Tab/cap Esomeprazole		40mg	32	20	69	3.45	245
Tab/cap Lansoprazole	2	15mg	28	53	98	1.84	84.90
Tab/cap Lansoprazole		30mg	62	45	174	3.86	286.66

Table 2. Drug cost, Cost ratio and percentage cost variation of Commonly used Parenteral Proton Pump Inhibitors available in India

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



Figures

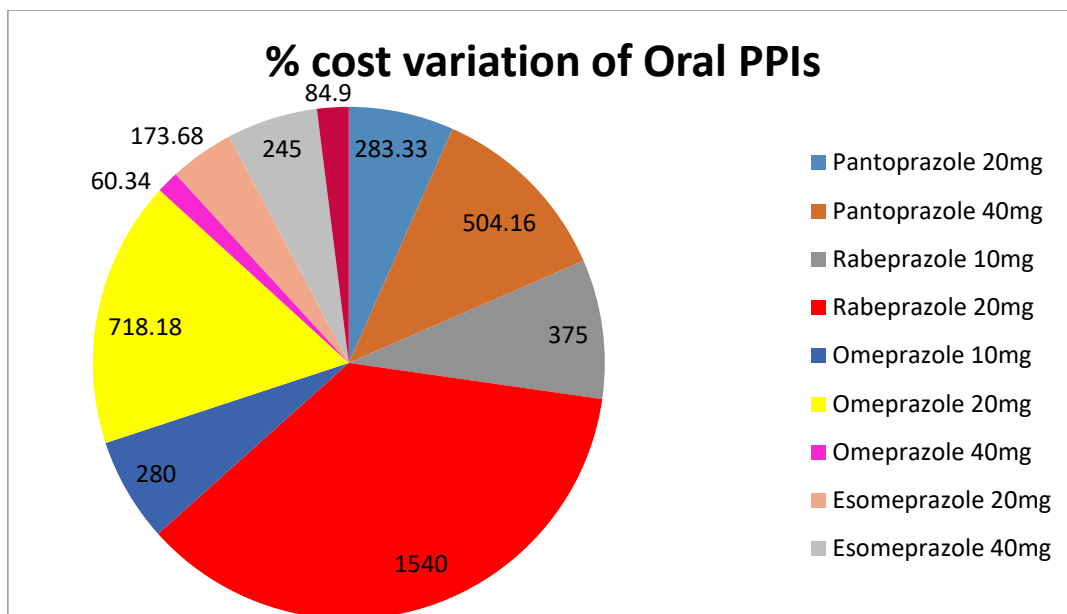


Figure 1. shows % Cost variation of Oral Proton Pump Inhibitors.

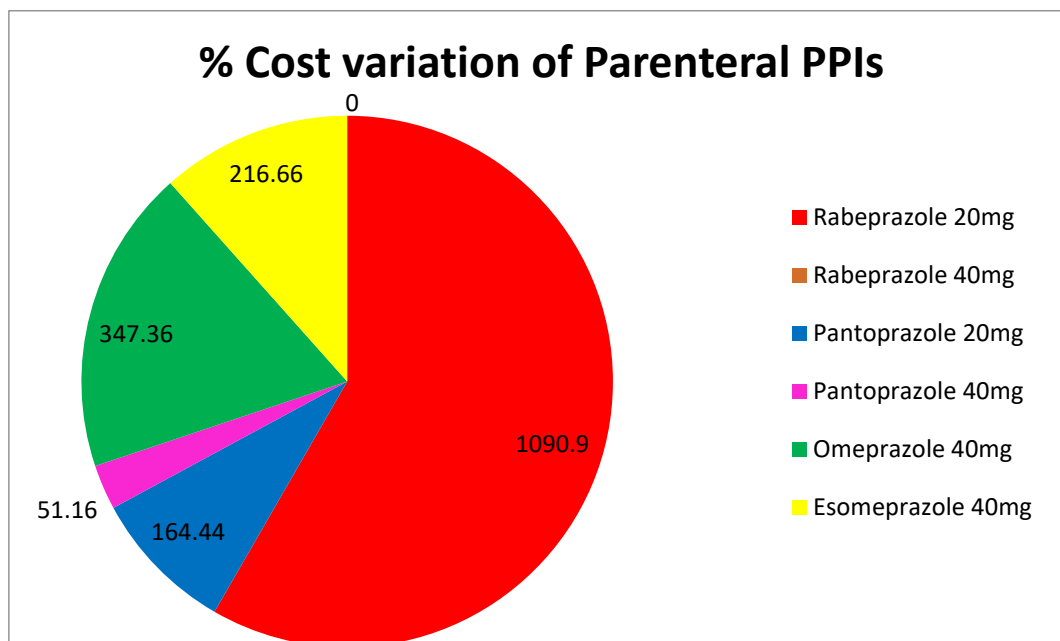


Figure 2. shows % Cost variation of Parenteral Proton Pump Inhibitors

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