

Variation in Cost among Anticancer Drugs Available in India: A Cross-sectional Study

RAMANAND JANARDHANRAO PATIL¹, PRASAN RAMCHANDRA BHANDARI², SANJAY DASHRATH GAIWALE³, VIVEK JAWAHAR DUGAD⁴, SANTOSH BABURAO JAGTAP⁵



ABSTRACT

Introduction: Cancer is an abnormal growth of cells, and it encompasses over 100 types of cancers that affect humans. Cancer management often involves a combination of radiation therapy, surgery, chemotherapy, and targeted therapy. Anticancer drugs, in general, tend to be more expensive compared to other categories of drugs, significantly contributing to the overall drug expenditure incurred by patients.

Aim: To analyse the percentage variation in cost among different brands of anticancer drugs available in the Indian market.

Materials and Methods: A cross-sectional study was conducted in the Department of Pharmacology at Symbiosis Medical College, Symbiosis International University, in Pune, Maharashtra, India. The study duration was six months, from March 2021 to August 2021. Data on the prices of anticancer drugs were collected and analysed using the October 2020 to January 2021 edition of the Current Index of Medical Specialities (CIMS). A total of 29 anticancer drugs with different strengths were considered. The cost of a particular anticancer drug with the same dose and dosage form produced by different companies was compared. Drugs were selected based on their strength and dosage forms. The cost of one tablet, capsule, or injection was calculated in

Indian Rupees (INR). The cost of a single unit was compared, and the difference between the maximum and minimum costs was calculated. Subsequently, cost ratios and the percentage of cost variation were determined. The study findings were recorded in both Microsoft Word 2016 and Excel 2016, and they were expressed as absolute numbers and percentages.

Results: Bortezomib 3.5 mg was the costliest among anticancer drug which was priced at INR 18,988.00, while the cheapest was methotrexate 2.5 mg tablet, priced at INR 1.886. Among the anticancer drugs, paclitaxel 260 mg injection had the highest cost ratio of 1 29.3055, whereas cisplatin 10 mg injection had the lowest cost ratio 1. Regarding cost variation, paclitaxel 260 mg injection showed the highest percentage of cost variation at 2830.5555%, while cisplatin 10 mg injection showed the lowest at 0%.

Conclusion: This study revealed a significant variation in prices, cost ratios, and cost variation among different anticancer drugs, providing insights into the price discrepancies observed in the market. The findings can help physicians and policymakers become aware of the cost variations among these drugs and make informed decisions regarding pricing.

Keywords: Cancer, Ceiling price, Cost analysis, Cost variation, Pharmacoeconomic

INTRODUCTION

Cancer is an abnormal growth of cells, also known as malignancy. Over 100 types of cancers affect humans, including breast cancer, skin cancer, lung cancer, colon cancer, prostate cancer, and lymphoma. Symptoms vary depending on the type of cancer. The treatment of cancer includes chemotherapy, radiation, and/or surgery [1]. Signs and symptoms may include a lump, prolonged cough, abnormal bleeding, weight loss, and a change in bowel habits [2]. Tobacco use is responsible for about 25% of cancer deaths [3]. Another 10% are attributed to obesity, poor diet, lack of physical activity, or excessive alcohol consumption [3-5]. Cancer is often treated with a combination of radiation therapy, surgery, chemotherapy, and targeted therapy [3,6]. As of 2019, approximately 18 million new cases occur annually worldwide [7]. In 2020, it was projected that there would be 1,392,179 cancer patients in India [8]. The most common types of cancer in males are lung cancer, prostate cancer, colorectal cancer, and stomach cancer. In females, the most common types are breast cancer, colorectal cancer, lung cancer, and cervical cancer [9]. Generally, anticancer drugs are more expensive than any other category of drugs and significantly contribute to the growing drug expenditure for patients [10].

In developed countries, where a medical insurance system is in place, affordability of anticancer drugs may not be a concern. However, in developing countries like India, where medical insurance is still emerging, affordability becomes a major issue [11]. Due to the lack of

comparative information on anticancer drug prices, it is challenging for clinicians to prescribe more affordable medicines. Very few studies on cost variation analysis of different anticancer drugs have been published. Adwal SK and Baghel R reported a wide variation in the prices of most anticancer drugs available in India, such as the alkylating agent carboplatin 150 mg injection (1100%) and the lowest variation with the antimetabolite anticancer agent cytarabine 500 mg injection (6.56%) [12]. Siddiqui M and Rajkumar SV reported difficulties in determining the true generic price and found that generic cancer drugs are costly in developed countries [13]. Prices of anticancer drugs are subject to regular changes, so this study focuses on the cost variation in the year 2020-2021 compared to past literature. It aims to help physicians and policymakers become aware of the cost variations among drugs and make informed decisions regarding pricing. Therefore, this study was designed to analyse the percentage variation in cost among different brands of anticancer drugs available in the Indian market.

MATERIALS AND METHODS

A cross-sectional study was conducted in the Department of Pharmacology at Symbiosis Medical College, Symbiosis International University, Pune, Maharashtra, India. The study duration was six months, from March 2021 to August 2021. The study received approval from the Institutional Ethics Committee (IEC) with approval number SIU/IEC/213. Data on the prices of anticancer drugs

were collected and analysed using the Current Index of Medical Specialities (CIMS) from October 2020 to January 2021. A total of 29 anticancer drugs with different strengths were considered.

Inclusion criteria: Drugs with the same strengths but manufactured by different companies and with the same strength and quantity were included in the study.

Exclusion criteria: Drugs manufactured by only one company with different strengths were excluded. Drugs without available cost information were also excluded from the study.

Study Procedure

A total of 29 anticancer drugs with different strengths were considered. Anticancer drugs available in different dosage forms, such as oral and parenteral, were analysed for their costs. The cost of anticancer drugs was also analysed according to different classes, such as alkylating agents, topoisomerase-2 inhibitors, and proteasome inhibitors. The cost of a particular anticancer drug with the same dose and dosage form, manufactured by different companies, was compared. Drugs manufactured by only one company or by different companies with different strengths, as well as drugs without cost information, were excluded. Drugs were selected based on their strength and dosage forms. The cost of each brand was entered into a table. Tablets, capsules, or injections with the same quantity were selected. The costs of these dosage forms were compared and calculated in INR.

The difference between the maximum and minimum costs was calculated. Then, the cost ratio and percentage of cost variation were calculated [14]. The following formula was used to calculate the price variation:

$$\text{Percentage price variation} = \frac{\text{Price of the most expensive brand} - \text{Price of the least expensive brand}}{\text{Price of the least expensive brand}} \times 100$$

The cost ratio was calculated by dividing the costliest brand by the cheapest brand, showing how many times the costliest brand is more expensive than the cheapest brand [15].

STATISTICAL ANALYSIS

The data from the study was entered into both Microsoft Word 2016 and Excel 2016 and expressed as absolute numbers and percentages. The percentage of cost variation and cost ratio were calculated using the findings. Tables, figures, and charts were used to represent the data.

RESULTS

Anticancer drugs: The drugs were selected from 13 different classes in the study.

- **Alkylating agents:** Among the alkylating agents, the costliest drug is bendamustine (100 mg injection; INR 9,134.00), and the cheapest drug is temozolomide (20 mg capsule; INR 280.00). The cost ratio of temozolomide (100 mg capsule; 2.1468) is the highest, and that of temozolomide (250 mg capsule; 1.6309) is the lowest. The cost variation of temozolomide (100 mg capsule; 114.6881%) is the highest, while that of bendamustine (100 mg injection; 21.1084%) is the lowest.
- **Platinum coordination complexes:** Among the platinum coordination complexes, the costliest drug is carboplatin (450 mg 45 mL injection; INR 5,900.00), and the cheapest drug is cisplatin (10 mg injection; INR 67.00). The cost ratio of carboplatin (150 mg 15 mL injection; 3.1002) is the highest, and that of cisplatin (10 mg injection; 1) is the lowest. The cost variation of carboplatin (150 mg 15 mL injection; 210.0252%) is the highest, while that of cisplatin (10 mg injection; 0%) is the lowest.
- **Antimetabolites:** Among the antimetabolites, the costliest drug is pemetrexed (500 mg injection; INR 17,000.00), and the cheapest drug is methotrexate (2.5 mg tablet; INR 1.886).

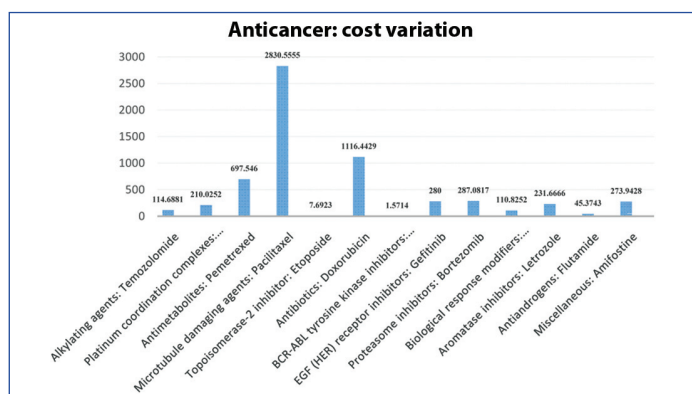
The cost ratio of pemetrexed (100 mg injection; 7.9754) is the highest, and that of methotrexate (10 mg tablet; 1.0190) is the lowest. The cost variation of pemetrexed (100 mg injection; 697.5460%) is the highest, while that of methotrexate (10 mg tablet; 1.9038%) is the lowest.

- **Microtubule damaging agents:** Among the microtubule damaging agents, the costliest drug is docetaxel (120 mg/3 mL injection; INR 18,700.00), and the cheapest drug is paclitaxel (260 mg injection; INR 360.00). The cost ratio of paclitaxel (260 mg injection; 29.3055) is the highest, and that of docetaxel (80 mg/2 mL injection; 1.1147) is the lowest. The cost variation of paclitaxel (260 mg injection; 2830.5555%) is the highest, while that of docetaxel (80 mg/2 mL injection; 11.4767%) is the lowest.
- **Topoisomerase-2 inhibitor:** Among the topoisomerase-2 inhibitors, the costliest drug is etoposide (50 mg capsule; INR 476.00), and the cheapest drug is etoposide (100 mg injection; INR 182.00). The cost ratio and cost variation of etoposide were (50 mg capsule and 100 mg injection; 1.0769) and (50 mg capsule and 100 mg injection; 7.6923%), respectively.
- **Antibiotics:** Among the antibiotics, the costliest drug is doxorubicin (20 mg/10 mL injection; INR 3,625.00), and the cheapest drug is mitomycin (2 mg injection; INR 135.00). The cost ratio of doxorubicin (20 mg/10 mL injection; 12.1644) is the highest, and that of mitomycin (40 mg injection; 1.0305) is the lowest. The cost variation of doxorubicin (20 mg/10 mL injection; 1116.4429%) is the highest, while that of mitomycin (40 mg injection; 3.0534%) is the lowest.
- **Break Point Cluster (BCR)-Abelson (ABL) tyrosine kinase inhibitors:** Among BCR-ABL tyrosine kinase inhibitors, the costliest drug is imatinib (400 mg tablet; INR 213.3), and the cheapest drug is imatinib (400 mg tablet; INR 210). The cost ratio and cost variation of imatinib were (400 mg tablet; 1.0157) and (400 mg tablet; 1.5714%), respectively.
- **Epidermal Growth Factor (EGF) [Human Epidermal Growth Factor Receptor (HER)] receptor inhibitors:** Among EGF (HER) receptor inhibitors, the costliest drug is gefitinib (250 mg tablet; INR 950.00), and the cheapest drug is gefitinib (250 mg tablet; INR 250). The highest cost ratio is of gefitinib (250 mg tablet; 3.8), and the lowest is of erlotinib (150 mg tablet; 1.0587). The highest cost variation is of gefitinib (250 mg tablet; 280%), and the lowest is of erlotinib (150 mg tablet; 5.8705%).
- **Proteasome inhibitors:** Among proteasome inhibitors, the costliest drug is bortezomib (3.5 mg injection; INR 18,988), and the cheapest drug is bortezomib (2 mg injection; INR 3,228.00). The highest cost ratio is of bortezomib (2 mg injection; 3.8708), and the lowest is of bortezomib (3.5 mg injection; 2.5079). The highest cost variation is of bortezomib (2 mg injection; 287.0817%), and the lowest is of bortezomib (3.5 mg injection; 150.7991%).
- **Biological response modifiers:** Among biological response modifiers, the costliest drug is interferon alfa-2B (5MIU injection; INR 2,835.60), and the cheapest drug is interferon alfa-2B (3MIU injection; INR 892.85). The highest cost ratio is of interferon alfa-2B (5MIU injection; 2.1082), and the lowest is of interferon alfa-2B (3MIU injection; 1.9996). The highest cost variation is of interferon alfa-2B (5MIU injection; 110.8252%), and the lowest is of interferon alfa-2B (3MIU injection; 99.9663%).
- **Aromatase inhibitors:** Among aromatase inhibitors, the costliest drug is letrozole (2.5 mg tablet; INR 79.6), and the cheapest drug is letrozole (2.5 mg tablet; INR 24). The highest cost ratio is of letrozole (2.5 mg tablet; 3.3166), and the lowest is of anastrozole (1 mg tablet; 1.6468). The highest cost variation is of letrozole (2.5 mg tablet; 231.6666%), and the lowest is of anastrozole (1 mg tablet; 64.6857%).

- **Anti-androgens:** Among antiandrogens, the costliest drug is flutamide (250 mg tablet; INR 14.174), and the cheapest drug is flutamide (250 mg tablet; INR 9.75). The cost ratio of flutamide 250 mg tablet is 1.4537, and the cost variation is 45.3743%.
- **Miscellaneous:** Among miscellaneous drugs, the costliest drug is amifostine (500 mg injection; INR 13,088.00), and the cheapest drug is lenalidomide (5 mg capsule; INR 63.2). The highest cost ratio is of amifostine (500 mg injection; 3.7394), and the lowest is of hydroxycarbamide (500 mg capsule; 1.0353). The highest cost variation is of amifostine (500 mg injection; 273.9428%), and the lowest is of hydroxycarbamide (500 mg capsule; 3.5327%).
- **Maximum cost variation among anticancer drugs:** Among anticancer drugs, paclitaxel 260 mg injection (INR 2,830.5555) showed the highest cost variation. The maximum cost variation among anticancer drugs is shown in [Table/Fig-1a and b].

Drugs	Strength (in mg)	Dosage form	Cost variation (in %)
Maximum cost variation among anticancer drugs			
Alkylating agents			
Temozolomide	100 mg	Capsule	114.6881
Platinum coordination complexes			
Carboplatin	150 mg	Injection	210.0252
Antimetabolites			
Pemetrexed	100 mg	Injection	697.5460
Microtubule damaging agents			
Paclitaxel	260 mg	Injection	2830.5555
Topoisomerase-2 inhibitor			
Etoposide	50 mg/100 mg	Capsule	7.6923
Antibiotics			
Doxorubicin	20 mg/10 mL	Injection	1116.4429
BCR-ABL tyrosine kinase inhibitors			
Imatinib	400 mg	Tablet	1.5714
EGF (HER) receptor inhibitors			
Gefitinib	250 mg	Tablet	280
Proteasome inhibitors			
Bortezomib	2 mg	Injection	287.0817
Biological response modifiers			
Interferon alfa-2B	5 MIU	Injection	110.8252
Aromatase inhibitors			
Letrozole	2.5 mg	Tablet	231.6666
Anti-androgens			
Flutamide	250 mg	Tablet	45.3743
Miscellaneous			
Amifostine	500 mg	Injection	273.9428

[Table/Fig-1a]: Maximum cost variation among anticancer drugs. BCR: Break point cluster; ABL: Abelson; EGF: Epidermal growth factor; HER: Human epidermal growth factor receptor



[Table/Fig-1b]: Maximum cost variation among anticancer drugs.

DISCUSSION

Cancer involves abnormal cell growth and has the potential to invade or spread to other parts of the body [3,16]. The prices of drugs in the Indian market are regulated by the National Pharmaceutical Pricing Authority (NPPA), Government of India. The NPPA fixes the ceiling price of a drug based on its essentiality. Pharmaceutical companies are required to set the price of their products equal to or below the ceiling price specified in the Drugs Prices Control Order (DPCO) [17]. The 21st World Health Organisation (WHO) model list of essential medicines (2019) also includes many anticancer drugs [18].

Cancer was chosen as the focus because it is one of the most common disorders in India and worldwide, causing significant morbidity and mortality, and requiring prolonged prescription. Data from CIMS between October 2020 and January 2021 was selected for data collection and analysis. Among anticancer drugs, the costliest drug is bortezomib 3.5 mg injection (INR 18,988.00), and the cheapest drug is methotrexate 2.5 mg tablet (INR 1.886). Among anticancer drugs, paclitaxel 260 mg injection (29.3055) showed the highest cost ratio, while cisplatin 10 mg injection (1) showed the lowest cost ratio. Among anticancer drugs, paclitaxel 260 mg injection (2,830.5555%) showed the highest cost variation, while cisplatin 10 mg injection (0%) showed the lowest cost variation.

The findings of the present study show a high variation in prices among different anticancer drugs. Clinicians may prescribe costlier drugs due to the influence of pharmaceutical companies, despite the insistence of the Medical Council of India (MCI) to prescribe generic drugs instead of branded ones. Some patients believe that generic and cheap drugs will be less effective and may not cure or control cancer progression. However, there is no available information to prove that costlier drugs are more effective than cheaper ones [19]. Clinicians should be aware of the cost variation of drugs and prescribe generic and affordable options, as prescribing cheaper drugs may improve patient compliance. The government needs to take steps to regulate drug prices to ensure affordability for all citizens. It is the responsibility of all stakeholders, including doctors, pharmacists, patients, and authorities, to control drug prices. A study by Adwal SK and Baghel R showed a wide variation in the prices of most anticancer drugs available in India, with the highest variation observed in the alkylating agent carboplatin 150 mg injection (1100%) and the lowest in the anti-metabolite anticancer agent cytarabine 500 mg injection (6.56%) [12].

A study by Siddiqui M and Rajkumar SV highlighted the difficulty in determining the true cost of generic cancer drugs, even in developed countries [13]. Another study by Salmasi S et al., showed

- High price variation among anticancer drugs in South East Asian, Western Pacific and East Mediterranean region.
- Mean unit price in Oman was highest (INR 2355.60) and in Taiwan was lowest (INR 492.61) [20].

The findings of various similar studies are presented alongside the present study in [Table/Fig-2] [12,13,20].

S. No.	Authors and year of study	Findings
1	Adwal SK and Baghel R, (2019) [12]	Wide variation in the prices of most of the anticancer drugs available in India, such as alkylating agent carboplatin 150 mg injection (1100%) and lowest with anti-metabolite anticancer agent cytarabine 500 mg injection (6.56%).
2	Siddiqui M and Rajkumar SV, (2012) [13]	Difficulty in checking true generic price and found generic cancer drugs cost high in the developed countries.
3	Salmasi S et al., (2017) [20]	High price variation among anticancer drugs in South East Asian, Western Pacific and East Mediterranean region. Mean unit price in Oman was highest (INR 2355.60) and in Taiwan was lowest (INR 492.61).

4	Present study (2023)	Costliest anticancer drug is bortezomib 3.5 mg injection; 18988.00 and cheapest anticancer drug is methotrexate 2.5 mg tablet; 1.886. Anticancer drugs, paclitaxel 260 mg injection; 29.3055 showed highest cost ratio and cisplatin 10 mg injection; 1 showed lowest cost ratio. Anticancer drugs, paclitaxel 260 mg injection; 2830.5555% showed highest cost variation and cisplatin 10 mg injection; 0% showed lowest cost variation.
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[Table/Fig-2]: Findings of various studies and the present study [12,13,20].

Limitation(s)

A limitation of this study is the small number of references used. Only data from CIMS was utilised, and further studies are needed to gain a more comprehensive understanding of the cost variation of anticancer drugs. To better comprehend the cost of drugs, pharmacoeconomics should be included in the medical education curriculum. It is important to note that since this study was conducted in 2020-2021, the prices may not accurately reflect the current market prices.

CONCLUSION(S)

The present study has shown wide variation in the prices, cost ratios, and cost variation of anticancer drugs, helping to understand the price variation among different anticancer drugs. This will assist physicians and policymakers in becoming aware of the cost variations among drugs and making informed decisions regarding prices.

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PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Pharmacology, Symbiosis Medical College for Women, Symbiosis International (Deemed University) (SIU), Lavale, Taluka Mulshi, Pune, Maharashtra, India.
2. Professor and Head, Department of Pharmacology, Symbiosis Medical College for Women, Symbiosis International (Deemed University) (SIU), Taluka Mulshi, Pune, Maharashtra, India.
3. Associate Professor, Department of Forensic Medicine and Toxicology, Symbiosis Medical College for Women, Symbiosis International (Deemed University) (SIU), Taluka Mulshi, Pune, Maharashtra, India.
4. Assistant Professor, Department of Pathology, Symbiosis Medical College for Women, Symbiosis International (Deemed University) (SIU), Taluka Mulshi, Pune, Maharashtra, India.
5. Associate Professor, Department of Biochemistry, Symbiosis Medical College for Women, Symbiosis International (Deemed University) (SIU), Taluka Mulshi, Pune, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Ramanand Janardhanrao Patil,
Associate Professor, Department of Pharmacology, Symbiosis Medical College for Women, Symbiosis International (Deemed University) (SIU), Taluka Mulshi, Pune-412115, Maharashtra, India.
E-mail: ramanand004@gmail.com; ramanand.patil@smcw.siu.edu.in

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