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Cost Minimisation Analysis of IV Antibiotics

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Abstract

Antibiotic resistance is a growing concern worldwide. Minimizing the use of antibiotics is essential to slow this trend. Cost minimisation is also important, as antibiotics can be expensive. Implementing policies to encourage responsible use and developing new treatments can help reduce the need for antibiotics. By doing so, we can protect the efficacy of current antibiotics and save money in the long run. The present study focused on evaluating IV antibiotics and conducting a cost minimization analysis. The study compares the maximum and minimum prices of various branded and generic antibiotic drugs available in India using CIMS 2022 edition. The cost ratio and cost variation percentage for individual drugs were calculated and compared. The highest percentage of cost variation was seen among Gentamicin 80 mg, Meropenem 1 gm, Piperacillin + Tazobactam 4.5 gm and the lowest percentage of cost variation was seen among Vancomycin 1gm, Linezolid 600 mg and Vancomycin 500 mg. The findings indicated that the selection of appropriate antibiotics is crucial in ensuring effective cost minimization of antibiotic usage among patients.

Keywords: IV Antibiotics, Cost Minimisation, Cost Ratio, Cost Variation

Introduction

Pharmacoeconomics is a branch of health economics that deals with the study of the costs and outcomes associated with pharmaceutical products and services [1]. It involves the evaluation of the value of different drugs and interventions, taking into account their costs, benefits, and risks. The goal of pharmacoeconomics is to provide decision-makers with the information they need to make informed choices about which drugs to use and how to allocate healthcare resources. This can involve analyzing the cost-effectiveness of different treatments, assessing the impact of new drugs on overall healthcare spending, and examining the impact of different healthcare policies on patient outcomes. Some of the key concepts in pharmacoeconomics include cost-benefit analysis, cost-effectiveness analysis, cost minimisation, cost of illness and cost-utility analysis [2].

Cost minimisation is an important concept in healthcare economics. It refers to the process of reducing the cost of healthcare services while maintaining the quality of patient care. This is achieved by identifying ways to eliminate unnecessary expenses and reducing waste [2]. The use of cost minimisation techniques

can be beneficial in reducing the overall cost of healthcare, which can help to make healthcare services more accessible and affordable for patients. Some examples of cost minimisation strategies in healthcare include the use of generic medications, reducing unnecessary diagnostic tests and procedures, and implementing preventative measures to reduce the need for costly treatments. Overall, cost minimisation plays an important role in healthcare economics as it helps to ensure that patients receive high-quality care at an affordable cost [3]. In October **(2019) Bhandari et al.,** published an article which discussed that healthcare practitioners should consider pharmacoeconomic aspects when prescribing antibiotics for infectious disease treatment. This can improve compliance, decrease antibiotic resistance, and prevent treatment failure [4].

Antibiotics are drugs used to treat bacterial infections. They work by killing or stopping the growth of bacteria [5]. There are many different types of antibiotics available, each with a unique mode of action and spectrum of activity. Penicillin are a type of antibiotic that are commonly used to treat infections caused by gram-positive bacteria. They work by interfering with the bacterial cell wall synthesis. Examples of Penicillin include amoxicillin, ampicillin, and Penicillin G. Cephalosporin are another type of antibiotic that are similar in structure to Penicillin. They are also effective against gram-positive bacteria, but are often used to treat infections caused by gram-negative bacteria as well. Examples of Cephalosporin include ceftriaxone, cefuroxime, and cephalexin [5].

Macrolides are a class of antibiotics that are effective against a wide range of bacteria. They work by inhibiting bacterial protein synthesis [5]. Examples of macrolides include azithromycin, clarithromycin, and erythromycin. Tetracycline are a type of antibiotic that are effective against a broad range of bacteria. They work by inhibiting bacterial protein synthesis. Examples of Tetracycline include doxycycline, minocycline, and tetracycline. Restricted antibiotics are antibiotics that are only available by prescription and are reserved for use in specific situations. These antibiotics are often reserved for the treatment of serious infections or infections caused by antibiotic-resistant bacteria. Examples of restricted antibiotics include vancomycin, linezolid, and carbapenems [5].

It is a commonly observed fact that the cost of different branded preparations of the same drug varies greatly [1]. Physicians worry about generic drug quality, but **Surawanshi et.al** (2017) found the same antimicrobial activity in branded and generic antibiotics. The cost benefit is mainly for retailers, so steps should be taken to benefit patients too [6].

The gross variation in the cost of different branded preparations of the same drug can be attributed to a number of factors such as research and development costs, marketing expenses, and patent protection [3]. It is important for patients to be aware of these factors when choosing a medication and to consult with their healthcare provider to determine the best option for their individual needs. The differential pricing of medicines has been handled by the Government of India at least to some extent through periodic notification of Drug Price Control Orders (DPCOs), which fix prices for essential and affordable drugs. The National Pharmaceutical Pricing Authority (NPPA) implements this in turn [3].

Materials and Methods

The prices of various intravenous (IV) antibiotics were recorded from CIMS (Current Index of Medical Specialities) 2022. The minimum and maximum cost in rupees (INR) of an IV antibiotic drug manufactured by different pharmaceutical companies in the same dose strength was noted. The cost of one ampoule/vial were calculated.

The cost ratio is defined as the ratio of the maximum cost of the drug to the minimum cost of the drug. It was calculated for all the included IV antibiotics. Cost ratio is a measure used to compare the cost of drugs in relation to the most expensive and least expensive brand of the drug available in the market. By doing so, we can determine how cost-effective a particular drug is compared to its alternatives in the market. The percentage of cost variation can be calculated by the formula:

Percentage of cost variation = (Maximum cost - Minimum cost ÷ Minimum cost) x 100. [3].

Results

For pharmacoeconomic analysis, the prices of a total of ten parenteral preparations of antibiotics manufactured by different pharmaceutical companies were evaluated in the present study. Cost distribution of various IV antibiotics are shown in Table 1.

Table 1: Cost distribution of various IV antibiotics

S.No	Drug	Formulation	Strength	No of vials	Minimum Cost (Rs)	Maximum Cost (Rs)
1	Piperacillin + Tazobactam	Injection	4 gm + 500 mg	1	44.9	900
2	Ceftriaxone	Injection	1 gm	1	30	123.75
3	Cefoperazone + Sulbactam	Injection	1 gm + 500 mg 500 mg + 500 mg	1 1	80 65	425 575
4	Meropenem	Injection	1 gm 500 mg	1 1	139.5 490	2850 1390
5	Doxycycline	Injection	100 mg	1	92.25	770
6	Clindamycin	Injection	600 mg	1	154.05	390
7	Linezolid	Injection	600 mg	1	361	510.15
8	Vancomycin	Injection	500 mg 1 gm	1 1	250 610	495 778
9	Amikacin	Injection	250 mg 500 mg	1 1	23.35 13	60.5 90
10	Gentamicin	Injection	40 mg 80 mg	1 1	6 6.6	34 330

- Minimum cost is the cost of least costly brand from CIMS
- Maximum cost is the cost of highest costly brand from CIMS

Among the 10 IV antibiotic formulations there is a gross difference between minimum and maximum cost in most of the formulations. Table 2 and figure 1 represents the cost ratio of various IV antibiotics. Highest cost ratio was seen with Gentamycin 80mg, Meropenem1gm and Piperacillin/Tazobactam 4.5gm.

Lowest cost ratio was seen with Vancomycin 1gm, Linezolid 600mg, Vancomycin 500mg. Percentage of cost variation of various IV antibiotic formulations are depicted in table 3 and figure 2. Highest percentage of cost variation was seen with Gentamycin 80mg, Meropenem1gm and Piperacillin/Tazobactam 4.5gm. Lowest percentage of cost variation was seen with Vancomycin 1gm, Linezolid 600mg, Vancomycin 500mg.

Table 2: Cost ratio of various IV antibiotics

S.No	Drug	Strength	Cost ratio
1	Piperacillin + Tazobactam	4.5g	20.04
2	Ceftriaxone	1g	4.12
3	Cefoperazone + Sulbactam	1g + 500mg 500mg + 500mg	5.31 8.84
4	Meropenem	1g 500mg	20.43 2.83
5	Doxycycline	100mg	8.34
6	Clindamycin	600mg	2.53
7	Linezolid	600mg	1.41
8	Vancomycin	500mg 1g	1.98 1.27
9	Amikacin	250mg 500mg	2.59 6.9
10	Gentamicin	40mg 80mg	5.6 50

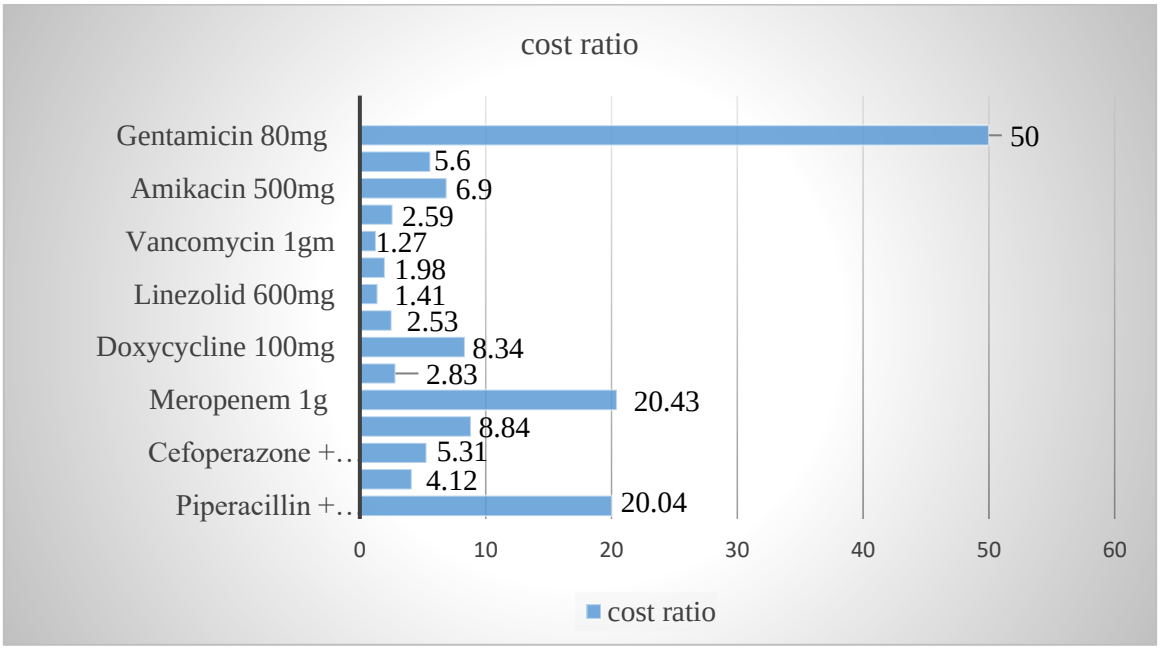

Fig 1: Cost Ratio of various IV antibiotic formulations

Table 3: Percentage of cost variation of various IV antibiotics

S.No	Drug	Strength	% cost variation
1	Piperacillin + Tazobactam	4.5g	1904.45
2	Ceftriaxone	1g	312.5
3	Cefoperazone + Sulbactam	1g + 500mg 500mg + 500mg	431.25 784.61
4	Meropenem	1g 500mg	1943.01 183.67
5	Doxycycline	100mg	734.68
6	Clindamycin	600mg	153.16
7	Linezolid	600mg	41.31
8	Vancomycin	500mg 1g	98 27.54
9	Amikacin	250mg 500mg	159.10 592.30
10	Gentamicin	40mg 80mg	466.66 4900

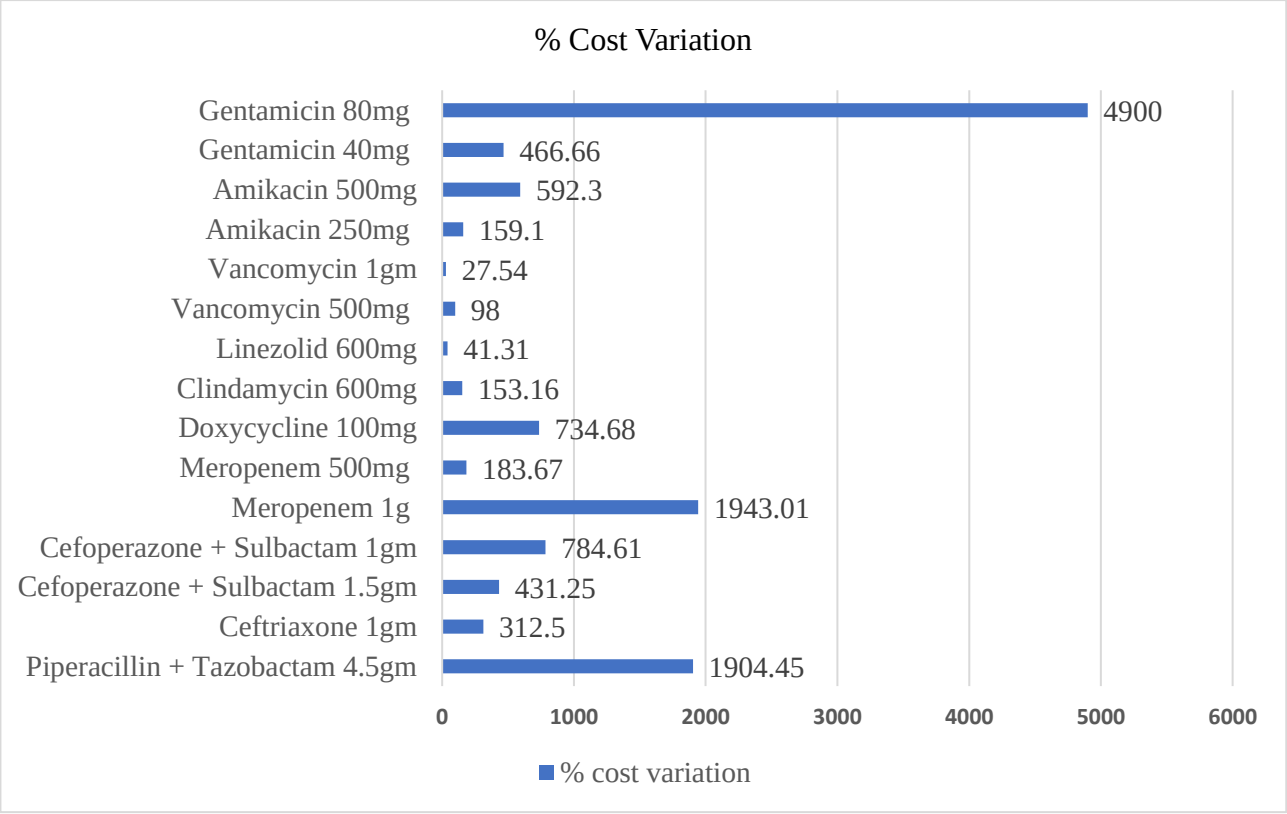

Fig 2: Percentage Cost Variation of various IV antibiotic formulations

Discussion

The cost of drug therapy is one of the biggest concerns among Indian patients. In India, it is estimated that more than half of medical expenses are paid by the patient. This means that a significant portion of healthcare costs are borne by individuals, rather than being covered by insurance or government programs. The high cost of healthcare is a major challenge for the Indian healthcare system, and efforts are being made to address this issue through various means such as increasing insurance coverage and promoting preventative care. In spite of these efforts, India still suffers from a significant burden of medical expenses. In India, the pharmaceutical industry has been grappling with the issue of wide variations in the prices of generic and branded drugs. Many pharmaceutical companies sell their drugs under different generic and brand names, which has further complicated the issue. In spite of attempts to reduce inter-brand cost variances, popular antibacterial formulations still show widespread variations. A large number of antibiotics are prescribed in India unnecessarily, resulting in higher healthcare costs for patients [4].

R. Sigmund (2004) discovered that 'watch' antibiotics account for most antibiotic consumption. Overuse of these and 'reserve' antibiotics can lead to antimicrobial resistance and therefore rational use is recommended. In literature, there is recognition of the need to minimize antibiotic treatment and use cost-reducing strategies, such as prior oral delivery, early oral administration, and avoiding broad-spectrum antibiotics [8].

When analyzing costs, it's important to consider the cost ratio and percentage of cost variation. The cost ratio becomes significant when it exceeds 2, and the percentage of cost variation becomes significant when it exceeds 100. These benchmarks help to identify where cost variation is most impactful [3].

A study conducted by **Srivastava et al** (2019) revealed that the maximum cost variation among parenteral preparations was for meropenem 1gm and among the oral formulations was found for levofloxacin 500mg followed by linezolid 600mg [9]. This study correlates with current study in which the maximum cost variation among the various IV antibiotics was identified for Gentamicin 80 mg followed by meropenem 1gm and the minimum cost variation was for vancomycin 1gm followed by linezolid 600mg.

Bandari et al (2019) demonstrated that the combination of cefoperazone 1000mg and sulbactam 1000mg was having the highest cost variation with a percentage cost variation of 212.5 [5]. These results were in par with findings of the current study.

The findings of a study by **Kumar DK et al** (2021) is similar to the present study which shows that the total unit cost was found to be higher in meropenem in the prescriptions [10].

The study conducted on the Indian market for IV formulations of antibiotics has found a significant variation in their prices. These findings emphasize the need for careful consideration while purchasing

such medicines.

The results of the current study reveal that the highest cost ratio was seen with

1. Gentamicin 80 mg
2. Meropenem 1 gm
3. Piperacillin + Tazobactam 4.5 gm

The lowest cost ratio was seen with

1. Vancomycin 1gm
2. Linezolid 600 mg
3. Vancomycin 500 mg

The highest percentage of cost variation was seen among

1. Gentamicin 80 mg
2. Meropenem 1 gm
3. Piperacillin + Tazobactam 4.5 gm

The lowest percentage of cost variation was seen among

1. Vancomycin 1gm
2. Linezolid 600 mg
3. Vancomycin 500 mg

The high cost of medicines is a significant factor in poor compliance, resulting in non-compliance or partial compliance in patients. This can have negative consequences on health outcomes and increase the risk of complications. Medication compliance is the degree to which a patient follows the prescribed medication regimen in terms of timing, dosage, frequency, and duration. It is crucial for optimal treatment outcomes and to prevent adverse effects. Noncompliance can lead to treatment failure, disease progression, and increased healthcare costs. Prescription of high-quality generic drugs that are equally effective as branded drugs could enhance patient compliance and consequently lead to better outcomes in managing antibiotic resistance. This approach not only assures patients of affordability but also encourages adherence to treatment protocols, reducing the likelihood of antibiotic resistance [8].

Minimizing antibiotic costs is one way to address this issue of increased morbidity, mortality, and healthcare costs. Healthcare providers can minimize antibiotic costs by prescribing antibiotics only when necessary and selecting the most cost-effective treatment.

Conclusion

The present study focused on evaluating IV antibiotics and conducting a cost minimization analysis. The findings indicated that the selection of appropriate antibiotics is crucial in ensuring effective cost minimization of antibiotic usage among patients. The selection of appropriate antibiotics and minimizing the cost burden of drugs can lead to better outcomes for patients with infectious conditions. There is a need for improvement in drug price regulatory mechanisms.

Pharmacoeconomic analyses can greatly reduce the economic burden of treating infections on patients. Eliminating cost variations between branded and generic prescriptions is also important. These measures can lead to more cost-effective recommendations for treatment, ultimately benefiting patients financially. Health care professionals should also be mindful of the prices of drugs when prescribing to reduce the out-

of-pocket expenses of their patients. Clinical pharmacists can ensure the rational use of antibiotics, emphasizing their importance in the healthcare system.

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