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A Cross Sectional Study on the Cost Effectiveness of Antibiotics Used In Intensive Care Unit Patients Attending Tertiary Care Hospital

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ABSTRACT

Background: In intensive care units (ICU), antibiotics are routinely prescribed to treat severe infections. cost-effectiveness analysis (CEA) is a technique used to assess the outcomes and costs of different strategies aimed at improving health, and has been utilized in various scientific disciplines.

Aim And Objectives: To identify the most commonly prescribed antibiotics in ICU and To estimate the cost of antibiotics used in ICU patients.

Materials And Methods: After IEC approval, This Cross sectional observational study was conducted in Medical Record Department of MAPIMS Hospital for 6 months. Sample size was found to be 385. The Indian Drug Review and the Current Index of Medical Specialties provide the brand cost of the medication

Results: In this study, antibiotics were prescribed in 231 out of 312 case records accounting 74%. The cost per dose in ICU patients ranges from Rs 7.55 to Rs 800 (per dose). The most commonly prescribed injectable antibiotics were Ceftriaxonefollowed by Metronidazole, Piperacillin/Tazobactam, while**,** oral antibiotic was Tab. Doxycycline, Ciprofloxacin, Augmentin, Azithromycin, Taxim, ofloxacin and Linezolid

Conclusion: The most cost-effective antibiotics were Tab. Doxycycline and Inj. Ceftriaxone.. To alleviate the financial burden on healthcare facilities, it is essential to conduct regular prescription audits and modify antibiotic policies.

Keywords: *Intensive care units (ICU), Cost-effectiveness analysis (CEA), Antibiotics*

1. INTRODUCTION

In intensive care units (ICU), antibiotics are routinely prescribed to treat severe infections. The irrational use of antibiotics is a global issue and has been linked to increased healthcare expenses.[1]Pharmacoeconomics is a key factor in healthcare budgets, with a focus on cost-effectiveness analysis (CEA). CEA is a technique used to assess the outcomes and costs of different strategies aimed at improving health, and has been utilized in various scientific disciplines.[2]

India is the largest consumer of antibiotics in the world by volume, with annual in-patient antibiotic expenditure ranging from 16,780,275 INR in 2020 to 14,806,518 INR in 2021.[3]In an era of spiraling health care cost, India holds the 3rd position globally in terms of production volume, contributing to about 10% of the world's output by volume and 1.5% by value. Anti-infective medications account for the largest segment (16%) of the Indian pharmaceutical market.[4]

The extent of price variation is extensive, affecting nearly all categories of drugs.While the economic importance of ICU antibiotics is recognized, comprehensive economic evaluations are limited. Given the growing strain on constrained health care resources, research on these medications' cost-effectiveness are paramount importance.

Aim

The aim of this study was to analyze the cost of antibiotics used in intensive care unit.

Objectives:

- To identify the most commonly prescribed antibiotics in ICU

To estimate the cost of antibiotics used in ICU patients

2. MATERIALS AND METHOD

This study was reviewed and approved by IEC with waiver of consent. This research was performed in accordance with STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) recommendations for reporting observational studies. This Cross sectional observational study was conducted in Medical Record Department of MAPIMS Hospital for 6 months. Sample size was found to be 385 based on previous study[5], which was calculated using the formula n = (Z^2 * p * q) / E^2 (**n:** Sample size, **Z:** Z-score corresponding to the desired confidence level (e.g., 1.96 for 95% confidence, **p:** Estimated prevalence characteristic of interest, **q:** 1 – p ,**E:** Margin of error). Specialized case proforma form was used to collect the data.The costs considered in the CEA were associated withpharmacological treatment.Data was collected from caserecords of 385 patients admitted in ICU. The Indian Drug Review and the Current Index of Medical Specialties provide the brand cost of the medication.[6,7]Data was analyzed using SPSS version 29.0 software.

INCLUSION CRITERIA

All ICU patients irrespective of the disease condition whose length of stay ≥ 3 days

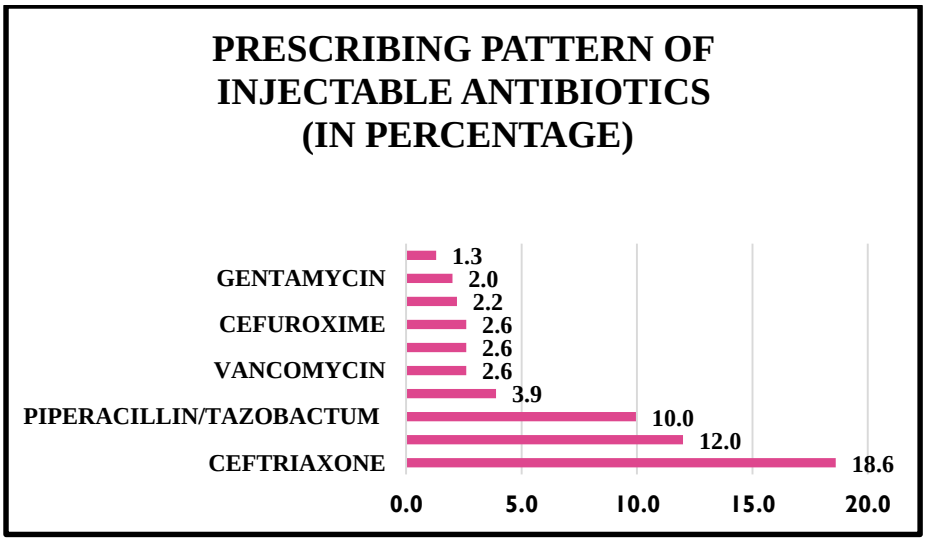
EXCLUSION CRITERIA

- Patients who died within 24 hours of admission
- Patients on insurance plan

3. RESULTS

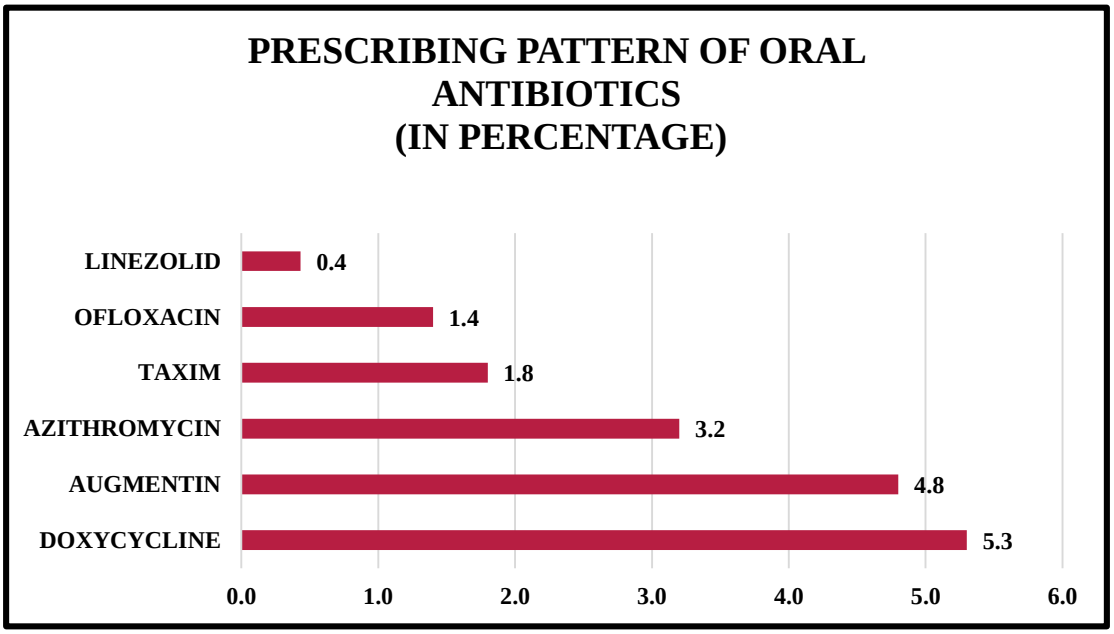
In this study, antibiotics were prescribed in 231 out of 312 case records accounting 74%. The rest case records had prescription for Hypertensive emergencies, poisioning, epilepsy. The cost per dose in ICU patients ranges from Rs 7.55 to Rs 800 (Rs 45.80 to Rs 4800 for 3 days as the doses are administered twice daily)

Fig 1: PRESCRIBING PATTERN OF INJECTABLE ANTIBIOTICS (IN PERCENTAGE)



The most commonly prescribed injectable antibiotics were Ceftriaxone (18.6%), followed by Metronidazole, Piperacillin/Tazobactam, and others such as Cefazolin, Vancomycin, Meropenem, Cefuroxime, Amikacin, Gentamicin (1.3%) and Cefoperazone/sulbactam as shown in Fig 1

Fig 2: PRESCRIBING PATTERN OF ORAL ANTIBIOTICS (IN PERCENTAGE)



The most commonly prescribed oral antibiotics include Doxycycline (1.3%), Ciprofloxacin, Augmentin, Azithromycin, Taxim,ofloxacin and Linezolid as shown in Fig 2.

Table 1: COST OF INJECTABLE ANTIBIOTICS PER DOSE

S.NO	ANTIBIOTICS (INJECTABLE)	DOSE	COST PER DOSE (INR)
1.	Ceftriaxone	1g	66
2.	Metronidazole	500 mg	21
3.	Piperacillin/Tazobactum	4.5mg	70
4.	Cefazolin	2g	35
5.	Vancomycin	500mg	300
6.	Meropenam	1g	800
7.	Cefuroxime	1.5g	72
8.	Clindamycin	600mg	215
9.	Amikacin	500mg	99
10.	Gentamycin	80mg	7.55
11.	*Cefoperazone/sulbactam*	1.5g	148

In this study, the most commonly prescribed injectable antibiotic was Inj. Ceftriaxone 1g which cost Rs 66, while the least was Inj.*Cefoperazone/sulbactam 1.5g costing Rs 148. The cost of injectable antibiotics range from Rs 7.55 to Rs 800 as shown in Table 1*

Table 2: COST OF ORAL ANTIBIOTICS PER DOSE

S.NO	ANTIBIOTICS (ORAL)	DOSE	COST PER DOSE (INR)
1.	Doxycycline	100mg	11.50
2.	Augmentin	625mg	20.47
3.	Azithromycin	500mg	26.40
4.	Cefotaxime	200mg	10.94
5.	Ofloxacin	200mg	9.74
6.	Linezolid	600mg	39.98

In this study, the most commonly prescribed oral antibiotic was Tab. Doxycycline which cost Rs 11.50, while the least was Tab. Linezolid*costing 39.98. The cost of oral antibiotics used in ICU range from Rs 9.74 to Rs 39.98 (per dose) as shown in Table 2*

4. DISCUSSION

ICU care is often expensive due to the critical nature of the patients and the advanced treatments they require. Antibiotics, especially broad-spectrum ones, are frequently used to treat infections in ICU patients. Understanding the cost-effectiveness of these antibiotics helps healthcare providers and administrators make informed decisions about resource allocation and budget planning, ensuring that high-quality care is delivered without unnecessary financial strain on the healthcare system.

The high expenses associated with treatment hinder patient adherence, elevate morbidity and mortality rates, and could lead to an increase in antimicrobial resistance. It's well-documented that there are significant price disparities among different brands in India. Currently, India has over 100,000 brands of various medications available for sale. Evaluating drug costs can raise moral and ethical dilemmas for prescribers, in addition to creating financial challenges for patients.[8]

A study conducted by Acharya P concluded that Inj. ceftriaxone is most frequently prescribed in ICU patients, which is more similar with this study.[9]This could be due to the reason that ceftriaxone – being noted for its high degree of protein binding, had increased clearance and volume of distribution in ICU patients.[10-12]Moreover ceftriaxone daily to ICU patients may improve treatment outcomes without increasing toxicity.[13]

Doxycycline is an effective and inexpensive therapy for the empirical treatment of hospitalized patients because, it achieves bioavailability of 93% after oral absorption.[14] In this study Doxycycline was the most preferred oral antibiotic which cost just Rs 11.50 only .

Inj. Meropenemused for complicated cases was the most expensive (Rs800 per gram). Pharmacoeconomic evaluations from a healthcare payer perspective in the UK, USand Russiaindicate that meropenem is a cost-effective treatment choice compared to other antibiotics for patients with severe infections in ICUs. Despite the fact that the purchase price of meropenem was higher than that of the alternative antibiotics in analysesthat factored in the cost of hospital stays, the overall expenses were lower with meropenem due to its superior clinical outcomes, which resulted in meropenem patients spending less time in an ICUand/or not needing additional antibiotic treatments.[15,16]

Inj. Metronidazole is regarded as a cost-efficient medication due to its affordable price (500mg cost Rs 21), effective action against pathogenic anaerobic bacteria, beneficial pharmacokinetic and pharmacodynamic characteristics, and minimal side effects.

Despite a decline in global usage due to newer alternatives for various infections, metronidazole continues to play a significant role in ICU patients treatment. Many healthcare professionals still view metronidazole as the ‘gold standard’ antibiotic, serving as a benchmark for evaluating other antibiotics with anaerobic efficacy.[17]

As suggested by Gonzalez LSGentamicin is the aminoglycoside used most often because of its low cost (Rs 7.55) and reliable activity against gram-negative aerobes. However, local resistance patterns influence the choice of therapy. [18,19]

In order to alleviate the economic impact of antibiotics, the ‘National Treatment Guidelines For Antimicrobial Use In Infectious Diseases’ were initially published in 2016 by the National Centre for Disease Control, Ministry of Health and Family Welfare, India. More recently, the ICMR released the ‘Treatment Guidelines for Antimicrobial Use in Common Syndromes’ (2nd edition) in 2019. It is anticipated that the management of bacterial infections in the country should follow the treatment protocols outlined in these guidelines. This presents a distinct opportunity to evaluate the costs associated with various regimens for bacterial infections, as well as examine the cost differences based on the use of branded versus generic medications.[20,21]

Moreover, encouraging the utilization of cost-effective generics and enhancing diagnostic methods to prevent unnecessary treatments is essential. Public education about the appropriate use of antibiotics, along with insurance reforms to decrease out-of-pocket expenses and reduce hospital stays, can help minimize overall treatment costs.

Limitations

Current study included ICU patients case records only

5. CONCLUSION

The most cost-effective antibiotics were Tab. Doxycycline and Inj. Ceftriaxone.. To alleviate the financial burden on healthcare facilities, it is essential to conduct regular prescription audits and modify antibiotic policies.

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