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Original Research Article

A cross-sectional observational study of postoperative restricted antibiotic utilization, rationality, and cost analysis in a tertiary care teaching hospital

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ABSTRACT

Background: Antimicrobial resistance (AMR) is an alarming condition that has been arising due to many interconnected factors, in particular, the use and misuse of antimicrobials. It is more prevalent in developing countries like India where there is a huge burden of infectious diseases. There has been insufficient research data to conclusively comment on the judicious use of antimicrobials. Therefore, this study is designed to assess the judicious use of antimicrobials on the basis of modified Kunin's criteria and analyse the cost and its rationality.
Methods: Cross sectional observational study wherein patient data for last 2-year postoperative patients was analyzed.
Results: In the present study, a significant number of patients (82.76%) the restricted antimicrobials were used judiciously and majority of then (42.19%) incurred a cost of <10000 INR.
Conclusions: The study shows that with appropriate and strict measures it is possible to limit the use of restricted antimicrobials. This further helps to decrease emerging antimicrobial resistance and also decrease the cost incurred by the patients during their hospital stay.

Keywords: AMR, Restricted antibiotics, Rationality, Cost analysis

INTRODUCTION

Antibiotics are the "magic bullets" for fighting against bacteria and are considered as the most remarkable medical discovery of the 20th century. The introduction of antibiotics has changed the therapeutic paradigm and continues to save millions of lives from bacterial infections. With their ever-increasing use and misuse, microorganisms have developed antimicrobial resistance (AMR).[1,2] AMR is a natural evolutionary process, but can be accelerated by human activity, and occurs when bacteria, viruses, fungi and parasites no longer respond to antimicrobial medicines. The history of AMR dates back to the discovery of penicillin, with the rise of multi-drug-resistant pathogens posing significant challenges to healthcare systems worldwide.[3,4]

AMR though being multi-factorial is mainly fuelled by the actions of both healthcare providers and consumers. From the consumer side, a major issue is the misuse of antibiotics many patients do not complete their full course of treatment, stopping once symptoms subside. This incomplete use allows bacteria to survive and develop resistance. Additionally, the easy availability of antibiotics over the counter, often without a prescription or proper guidance, leads to inappropriate and excessive use, further driving resistance. On the provider side, some healthcare professionals contribute by prescribing antibiotics unnecessarily or using restricted antimicrobials without clear clinical indications. This injudicious use weakens the effectiveness of these drugs and promotes the emergence of resistant strains. Treating infections caused by these multi-drug-resistant bacteria becomes significantly more

difficult and is associated with higher complication rates and mortality. Patients often require longer hospital stays, more expensive second- or third-line drugs, and intensive care, all of which increase the overall cost of treatment.[5-9]

While prevention will always remain the most effective strategy to reduce infections and, consequently, AMR, it is not sufficient on its own. There is a critical need for clear, evidence-based guidelines and protocols that govern the appropriate use of antimicrobials. More importantly, these guidelines must be strictly implemented and regularly monitored to ensure compliance by both healthcare providers and consumers. A structured and enforced approach not only promotes responsible antibiotic use but also helps preserve the effectiveness of existing treatments, making it a more reliable and sustainable method to combat AMR in the long term.[10-13] Thus, the main focus of this study is to analyse utilization, rationality and cost of restricted antibiotics in a tertiary care hospital.

METHODS

After taking the approval of Institutional Ethics Committee (SKNMC/Ethics/App/2022/983), this prospective observational study was carried out for 12 months at SKNMC and GH, a tertiary care hospital in western Maharashtra. The study design involves all patients with restricted antimicrobial agents (AMAs) prescribed to them post-operative. The records of patients in whom one or more restricted AMAs are prescribed was separated from the total records of admitted patients and put in increasing order. The treatment given to the patients was assessed at once. A pre-designed, structured proforma was used for collecting data from our medical records department (MRD) between April 2022 to April 2023. The proforma was divided into following sections; patients biodata, final diagnosis and underwent surgery, treatment history, and restricted AMA use characteristics which included signs and symptoms suggestive of infection and laboratory evidence of infection, indication for the use of restricted AMA whether therapeutic or prophylactic, availability of antibiotic sensitivity data, AMA prescribed (generic name, dose, dosage form, and frequency).The prescribed restricted AMAs were assessed on the basis of their cost. The cost of restricted AMAs used was calculated in INR and its affordability in the community was assessed. Analysis of rationality of antimicrobial agents was done by modified Kunin's criteria.[14] Following are the criteria details.

Category I

Agree with the use of therapy given as in the prescription. The treatment is appropriate in terms of choice of drug, dose, dosage regimen, duration of therapy.

Category II

Agree with the use of therapy but a potentially fatal infection cannot be ruled out.

Category III

Agree with the use of therapy but a different (usually less expensive and toxic) a combination of therapy is preferred.

Category IV

Agree with the use of therapy but a modified dose, dosage regimen and duration would be recommended.

Category V

Disagree with the use of therapy, administration is unjustified or unnecessary use of drugs.

We considered category I and II as appropriate selection of drugs and category III, IV and V was a major deficiency in choosing antibiotics by stakeholders. Data was then collected organized in Microsoft Excel sheet and analyzed in it in percentage and mean±SD format.

RESULTS

Table 1 lists the sociodemographics of 58 study participants. The mean age of the participants was 48.5±20.5; 41 were male and 17 were female. Overall mean duration of stay of the participants was 15.6±7.61. Among these 58 patients only 35 underwent cultural sensitivity testing before they were prescribed the restricted antimicrobials.

Table 1: Demographic characteristics of patients in surgery inpatients (n=58).

Characteristics	Number
Age groups (years)	
<18	3
18-30	12
31-50	16
51-70	17
>70	10
Gender	
Male	41
Female	17
Mean age±SD	48.5±20.5
Duration of hospital stay in days (mean±SD)	15.6±7.61
Culture sensitivity test done	35

Table 2 clearly shows that the patients prescribed with restricted antimicrobials mainly underwent gastroenterology surgeries (22.41%) followed by ulcer (17.24%) and abscess (15.51%).

Table 3 shows that when the appropriateness of the use of restricted antibiotics was studied on the basis of Kunin's criteria it was found that 82.76% of the patients were given restricted antibiotics appropriately while only in 17.24% the use of restricted antibiotics was inappropriate.

Table 2: List of the types of surgeries performed in the patients.

Age groups (years)	Number	Percentage
Fracture	1	1.72
Cellulitis	6	10.34
Ulcer	10	17.24
Urogenital surgeries	4	6.89
Gastroenterology surgeries	13	22.41
Abscess	9	15.51
Tumor	6	10.34
Post burn contracture	3	5.17
Others	6	10.34

Table 3: Analysis of case sheets for use of antibiotics as per Kunin's criteria.

Speciality - surgery department			Subtotal
Appropriate			
I	**II**		
34 (58.62%)	14 (24.14%)		48 (82.76%)
Inappropriate			
III	**IV**	**V**	
3 (5.17%)	6 (10.35%)	1 (1.72%)	10 (17.24%)
			58 (100%)

Table 4: Individual restricted antibiotics used and their unit and total cost.

Drug name	No. of prescript-tions	Unit cost (in INR)	Total cost (in INR)
Piperacillin+ Tazobactum	18	19803	356454
Feropenem	4	2597	10388
Colistin	1	74928	74928
Meropenem	16	40893.38	654294
Vancomycin	2	14820	29640
Linezolid	23	1022.6	23520

Table 5: Cost of total restricted antibiotic therapy.

Cost (in INR)	Antibiotic therapy	
	Number	Percentage
1000-10000	27	42.19
10001-20000	20	31.25
20001-30000	0	0
30001-40000	0	0
40001-50000	16	25
50001-60000	0	0
60001-70000	0	0
>70000	1	1.56

Tables 4 and 5 shows the cost assessment which tells us that majority i.e. 73.44% patients incurred a cost of less than 20,000 INR while only 1.56% incurred a cost of >70,000 INR.

It was also observed that Linezolid was the most used restricted antimicrobial followed closely by Piperacillin + Tazobactum and Meropenem. Least used antimicrobial was Colistin.

DISCUSSION

This study analyzed utilization, rationality and cost of restricted antibiotics in a tertiary care hospital. From above results, it was observed that out of 58 participants in the study, 41 (70.68%) were males, similar to studies done previously where 70.6% were males.[10] This may be due to the increased co-morbidities in the males for which they were hospitalized. Age of patients varied <18 years to >70 years, but 17 patients (29.31%) were between 51 years and 70 years followed very closely by 16 patients (27.58%) between 31 years and 50 years. The overall mean age was 48.44 while in the previous studies it was 58.35.[15]

The prevalence of increased co-morbidities in addition to the infectious diseases in these age groups could be the reason behind the increased usage of high-end antibiotics in them.

Our study showed that the most commonly prescribed medicine was Linezolid followed by Piperacillin + tazobactum and meropenem which is unlike the other studies where Meropenem was the most commonly prescribed.[10,15] Majority of the patients underwent gastroenterology surgeries followed by ulcer and abscess. Antimicrobials are prescribed in order to reduce the risk of surgical site infection.

Our study also showed how 82.76% of the restricted antimicrobials were prescribed for appropriate reasons which was higher than reported value 77.1% as in the other study.[10] It is most likely due to the existing strict guidelines and protocol for the use of restricted antimicrobials in our hospital. Etiopathogenesis of AMR is multifaceted but it has been proved by various studies that use antimicrobials judiciously can help decrease the resistance. When stricter guidelines and protocols are followed the past studies show that appropriate use of antibiotics go up from 77.1% to 88.3%.[12,15]

Hence, it is crucial to frame appropriate, evidence-based guidelines and ensure their strict implementation to promote the judicious use of restricted antimicrobials. This, in turn, will play a significant role in curbing the rising trend of antimicrobial resistance.

However, we have included data of only 58 patients hence results of this study cannot be generalized for that study with large sample size at different hospitals need to be undertaken and that is the limitations of this study.

CONCLUSION

This study demonstrated that the formulation and strict enforcement of guidelines ensure the judicious use of restricted antimicrobials, thereby contributing to more responsible prescribing practices and reducing the risk of antimicrobial resistance.

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