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Antimicrobial prescribing patterns and cost analysis study in intensive care units of tertiary level hospital

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ABSTRACT

Introduction: Examining antibiotic prescribing trends serves as a crucial gauge for assessing the quality and adherence to clinical practices.

Objective: To study the patterns of antimicrobial prescription and utilisation in different intensive care units (ICUs); the average expenditures on prescribed antimicrobials; and the association between antimicrobial usage and incurred costs.

Methodology: An observational cross-sectional study was conducted in different ICUs of Kathmandu Medical College from 2022 June to October. A total of 140 prescriptions of patients admitted in intensive care units were obtained by convenient sampling technique after ethical clearance. The total number of drugs and antibiotics, the class, dose, route, and cost of antimicrobials were noted. Data were analysed by SPSS v. 21.

Result: Among the 140 prescriptions studied, a total of 261 antimicrobials were prescribed with an average of 1.86 antimicrobial per prescriptions. Most of the prescriptions belonged to patients admitted in medical intensive care units. The average cost of antimicrobial in patient up to age 45 years was Nepali rupees 2,475.73/- and 8,987.25/- in patients aged more than 45 years.

Conclusion: Antimicrobials are prevalent in ICU prescriptions and substantially contribute to overall drug expenses. This study showed that ceftriaxone was the most frequently used antimicrobials in intensive care units. Moreover high utilisation rates and cost of antimicrobials prescribed in ICUs are significant concern that requires urgent attention through implementation of guidelines and antimicrobial restriction policies.

Keywords: Admission; antimicrobials; cost analysis; intensive care unit; prescriptions.

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INTRODUCTION

The admission of patients to intensive care units (ICUs) is commonly accompanied by the prescription of multiple broad-spectrum antimicrobials. This practice stems from the heightened severity of the patients' conditions, their exposure to various invasive procedures, and their increased susceptibility to multidrug resistant pathogens. Unfortunately, these antimicrobial prescriptions are often empirical, relying on physicians' familiarity and past experiences. Consequently, this approach frequently leads to the overuse or misuse of antimicrobials, posing a dual risk of escalating antimicrobial resistance and subjecting patients to unnecessary drug side effects, all while inflating treatment costs.[1-3]

The escalating challenge of multidrug resistance, coupled with the limited availability of new agents to combat emerging multidrug resistant clones,[4] underscores the critical necessity for proactive surveillance, rigorous infection control measures, and judicious antibiotic prescribing practices. In the context of ICUs in Nepal,

there is a notable scarcity of comprehensive data regarding antibiotic prescription practices, consumption patterns, and cost analyses, particularly during the initial phases of ICU admission.[1,2] Hence the primary objective of this study was to assess the antimicrobial prescribing pattern in intensive care units and the average cost of the antimicrobials prescribed.

METHODOLOGY

This was an observational, cross-sectional study of antimicrobial prescribing patterns in ICUs of Kathmandu Medical College Teaching Hospital, a tertiary hospital in Kathmandu which was conducted between 2022 June to 2022 October. This study was conducted after obtaining approval from Institutional Review committee of Kathmandu Medical College (Reference number: 2905202210). Taking Z = 1.96 at 95% confidence level; p = 0.10 (10%);[5] and e = 0.05 margin of error taken as 0.05 (5%), minimum sample size was found to be 139. A total of 140 prescriptions belonging to the patients admitted to intensive care units were taken in the study. Convenience sampling technique was utilised for sample collection. Prescriptions from Medical and Surgical intensive care units; such as medicine intensive care unit (MICU), surgical intensive care unit (SICU), paediatric intensive care unit (PICU) and neurosurgical intensive care unit were included in this study. Both sexes and prescription containing at least one antibiotics were included. Intravenous fluids were not included in the study. Prescriptions from neonatal intensive care unit were also excluded from the study.

The data were collected in predesigned proforma. Information such as demographic variables on all patients, such as name, age, gender, hospital number. duration of ICU admission, the total number of drugs prescribed on the day of admission, and the total number of antibiotics prescribed were also noted. Additional data such as dose, duration and route of administration of the antimicrobials were also noted. The daily antimicrobial cost per patient was calculated by the multiplication of the cost per unit and the number of doses that were used in each patient. The unit prices of each antimicrobial were obtained from the hospital pharmacy. The costs of the antimicrobials were calculated in Nepali currency.

After the data collection process was completed, the data were checked for completeness. Data were entered in Microsoft Excel sheet and exported to IBM SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, N.Y., USA) for further analysis. Mann-Whitney U test was used and p-value less than 0.05 were considered statistically significant.

RESULT

Prescriptions of 140 patients admitted into the ICU were analysed. This included prescriptions of 73 (52.2%) male and 67 (47.8%) female patients. Most of the patients in this study were admitted to the ICU were from the Internal Medicine and least from Orthopaedic department. In all maximum prescriptions (85, 60.7%) were from patients admitted in MICU followed by SICU. A total of 106 (75.7%) prescriptions contained 1-2 antimicrobials whereas only two prescriptions had five or more antimicrobial drugs. The average length of ICU stay was found to be 3.33 days. A total of 261 antimicrobials were prescribed in the current study at an average of 1.86 antimicrobial per prescriptions (Table 1). Ceftriaxone was the most frequently prescribed antimicrobials (Table 2). There was no statistical significance between the patients who were prescribed 1-2 antimicrobials and patients who were prescribed three or more antimicrobials with respect to their age. However, statistically significant difference was found between genders (Table 3).

The total cost of drugs prescribed in all the prescriptions was found to be 1,12,7261/- Nepali Rupees. Total cost of antimicrobials in all the prescriptions was found to be 8,28,445/- Nepali rupees. Thus, the total cost incurred by antibiotics was 73.49% of the total drug costs in the prescriptions analysed. The average cost of antimicrobials and average total cost of drugs prescribed were significantly lowered in the both age groups as shown by p-value less than 0.05. (Table 4).

Table 1: Distribution of patient characteristics

Characteristics	n (%)
Gender	
Male	73 (52.2)
Female	67 (47.8)
Age (years)	
Up to 45	66 (47.1)
More than 45	74 (52.9)
Unit	
MICU	85 (60.7)
SICU	33 (23.6)
Neuro ICU	14 (10.0)
PICU	8 (5.7)
Number of antimicrobial prescribed	
1-2	106 (75.7)
3-4	32 (22.9)
5 or more	2 (1.4)
Length of ICU stay (days)	
1-5	114 (81.4)
6-10	23 (16.4)
More than 10	3 (2.2)

Table 2: Most frequently prescribed antimicrobials

Antimicrobials	n (%)
Ceftriaxone	47 (18.0)
Piperacillin and tazobactam	28 (10.8)
Levofloxacin	25 (9.6)
Metronidazole	18 (6.9)
Amoxicillin and clavulinic acid	17 (6.5)
Meropenum	16 (6.1)
Clindamycin	10 (3.8)
Azithromycin	9 (3.4)
Doxycycline	9 (3.4)

DISCUSSION

In the current study average length of ICU stay was found to be 3.33 days which is similar to the study conducted in south India were the average length of ICU stay was found to be 3±2 days. These findings were different from the study conducted by Bergmans which showed the average ICU stay was seven days. Similar study was conducted in North India which showed the average length of stay in intensive care units was 5.2 days.[6]

The present study showed that most of the patients admitted in ICU were above 45 years of age (72, 52.9%) which is similar to the study conducted in Dehradhun (498, 55%) and in Pokhara (177, 68%) , Nepal where the mean age of the patients admitted in intensive care units was found to be 50 years.[7,8]

Table 3: Association of age of the patient and number of antimicrobials prescribed

Characteristics		1-2 antimicrobials	Three or more antimicrobials	p-value
Age (years)	Up to 45	50	16	0.130
	>45	56	18	
Gender	Male	49	24	0.030*
	Female	57	10	

p-value <0.05 significant *= Chi-square test

Table 4: Comparison of total drug and antimicrobial cost with respect to age

Variables	Median cost of antimicrobials	Interquartile range	Median cost of total drugs	Interquartile range	p-value
Age (years)					
Up to 45	2500	2475-4050	4300	4257-5545	0.013
More than 45	9100	8970-20590	14500	11436-22000	0.011

p-value <0.05 significant *= Mann-Whitney U test

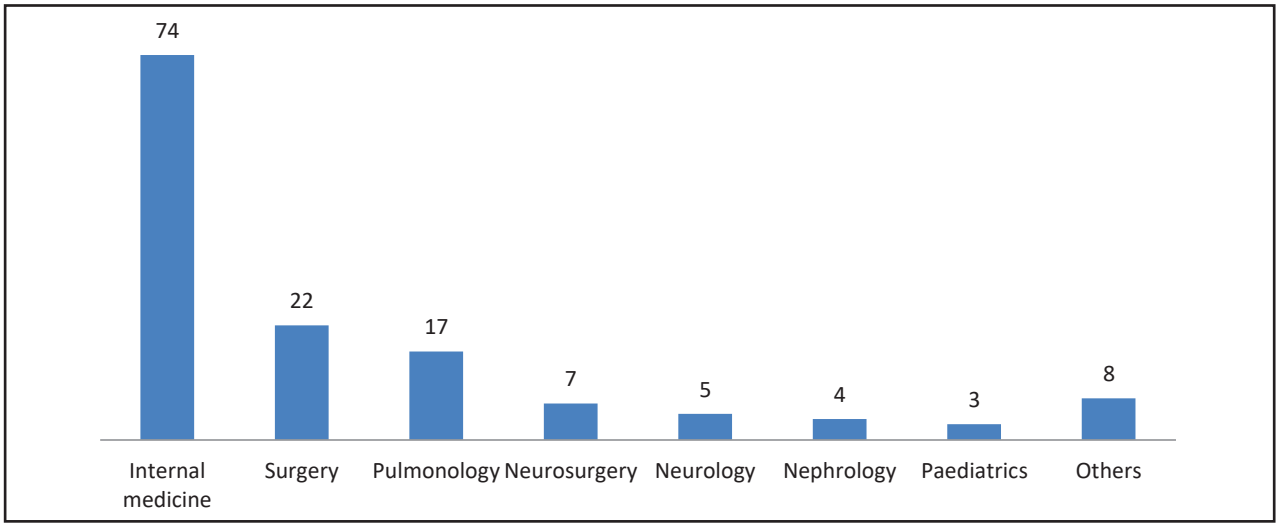

Figure 1: Department-wise distribution of prescriptions of patients

Ceftriaxone (47, 18.0%) was found to be most commonly prescribed antimicrobial agent in the present study. Ceftriaxone is a third generation cephalosporin to treat wide variety of bacterial infections. This findings are similar to the study conducted in a government medical college of Mysore where ceftriaxone was found to be most common antimicrobials.[9] However this findings were different from study conducted in Nepal which showed combination of piperacillin and tazobactam to be the most frequently prescribed antimicrobials.[10] Other similar studies conducted in Maharashtra, India showed tobramycin as the most frequently prescribed antimicrobials in intensive care units.[11] The differences among the studies were due to the different study sites and the practices adopted by the clinicians for managing the different conditions. Use of antimicrobials also depends upon the culture and sensitivity report as well.

In the current study most of the prescriptions belonged to patients admitted to medical intensive care units (85, 60%) which is similar to the study conducted in northern India which showed 69% of the patients belonged to medical intensive care unit. This finding tries to show that patients suffering from illness were of medical specialty tend to get admitted to intensive care units more as compared to other speciality.[12]

In the current study 106 (75.7 %) patients received 1-2 antimicrobials. A study in conducted Caribbean showed that 60% (533) of the patients received two antimicrobials[13] where as a study in Denmark showed that the patients admitted in ICU received one antimicrobial.[14] It is better to keep the antimicrobial usage as low as possible unless necessary as higher antimicrobial use tends to increase the risk of drug interactions, development of microbial resistance and treatment cost.

The average total cost of the drugs per prescriptions in the current study was found to be in the patients aged up to 45 years NPR 4,257.25/- and 11,436.26/- in the patients aged above 45 years. In the similar studies related to cost analysis of drugs Shankar et al. from Nepal report an average expenditure of Nepali Rs. 1958.53 ± 1267.8 on the drugs prescribed in ICU[7] and Biswal et al. have reported that patients spent about Nepali Rs. 19,725 on total drug costs and antibiotics contributed to 51.3% of the total drug expenditure.[15] In the western countries the average cost of drugs per day of the patients admitted in intensive care units was found to be between US $208 to US $312.[3] A similar study was conducted in Belgium showed the average cost of antibiotics was found to be €114.25 per patients.[16] Other study in turkey showed reported that cost of antimicrobials per day of ICU admitted patient was US $89.64. This differences suggests that facilities of the western countries in health sector were far expensive as compared to developing countries like Nepal.

CONCLUSION

The current study showed that antimicrobials were commonly prescribed in ICU settings of a tertiary hospital in Nepal and it contributed significantly to the total cost of drugs that was prescribed in the patients admitted in Intensive care units. Among antimicrobials ceftriaxone was the most frequently prescribed antimicrobials. The high utilisation rates and costs of antimicrobials prescribed at admission in the ICU are a matter of great concern and need to be urgently addressed by the use of guidelines of antibiotic restriction policies.

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