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Antibiotic Utilization Pattern in Inpatients of Intensive Care Unit in A Teaching Hospital, Biratnagar, Nepal.

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Abstract

Introduction: Antibiotics were the most often administered medication in intensive care units. In general, the ICU uses antibiotics around ten times more frequently than the hospital's general ward. The majority of patients hospitalized to intensive care units (ICUs) have many problems and are critically unwell and extremely susceptible to infections due to underlying diseases.

Objective: The objective of the study is to record antibiotic utilization pattern in ICU Setting.

Method: A prospective study was undertaken during the period of March to May 2022. Altogether 140 prescriptions were examined throughout the study period. The study was evaluated using modified International Network for Rational Use of Drugs (INRUD) form.

Result: All together total number of patients were 140, among them 83(59.29%) were male and 57(40.71%) were female. Commonly used antibiotic in injection dosage form were cephalosporins group which includes ceftriaxone (16.27%), piperacillin & tazobactam (13.48%) followed by fluroquinolones like levofloxacin (11.39%) and glycopeptides meropenam (7.20%). The current study shows that ceftriaxone (25.58 DDD/100 bed-days) was used most frequently, levofloxacin (6.03) and piperacillin/tazobactam (5.30). Average number of medicine costs were NRS.9149.89. and average costs of antibiotics per patients were NRS 5869.32. Total cost of prescribed antibiotics was NPR 821704.8

Conclusion: Our study demonstrates the high use of antibiotics in the hospital which is nearly 65 percent cost of total medicine. Hence, it needs immediate attention and in order to improve antibiotic use, antibiotic prescribing guideline and stewardship program implementation are highly recommended.

Keywords: Antibiotics; Drug utilization; Defined daily dose; Intensive care unit; Antibiotic utilization pattern.

Introduction

Antibiotics were the drugs most frequently administered within intensive care units.[1] Overall, antibiotics are administered approximately ten times more often in the ICU compared to the general ward of the hospital.[2] The majority of patients in ICU suffer from various severe conditions, are critically ill, and are particularly prone to infections because of underlying health issues. [3] In the ICU, antibiotics are typically given based on clinical judgment, often without waiting for culture sensitivity results.[4] The excessive and incorrect use of antibiotics contributes to higher antibiotic resistance, increased costs, greater side effects, and extended hospitalization. [5,6] The World Health Organization (WHO) defines drug usage as the sale, consumption, and prescription of medications within society, considering its medical, social, and economic impacts.[7] It serves as a crucial tool for studying the impact of population-level clinical medication use on the healthcare system.[8] Drug utilization studies are valuable for identifying expensive medications and understanding patterns of drug use. This study enhances the standard of medical care while also identifying issues like polypharmacy, drug interactions, and adverse drug reactions.[9] The concept of the defined daily dose (DDD) was introduced to address criticisms of traditional methods for measuring drug consumption. The DDD is defined as the average daily maintenance dose of a drug for adults when used over an extended period.[8] The cost of medication is a significant determinant in patient care, particularly in low-income countries.[10] One of the recommended approaches to prevent resistance and improve prescribing practices, based on the above information, is the monitoring and assessment of antimicrobial prescription patterns.[11] The Anatomical Therapeutic Chemical (ATC) Classification System was utilized to categorize antibiotics according to their intended use: empirical, prophylactic, or definitive. [12]

Method

A prospective research was conducted at Birat Medical College and Teaching Hospital, Biratnagar, Nepal, during the period of March to May 2022, after receiving ethical approval from Purbanchal University School of Health Science Institutional Review Committee (PUSHS-IRC) (Reference Number: 047-078/79). Intensive care unit patients were selected using a convenience sampling technique. Data were gathered through patient profile forms, treatment charts, and medication administration records. A one-week preliminary study was carried out to assess the effectiveness of the data collection forms. Following the pilot study, necessary adjustments and improvements were made to the data collection methods and other evaluation processes. Patients who participated in the preliminary study were excluded from main study. No compensation was provided to the patients, and their confidentiality was fully protected. The collected data were thoroughly reviewed and entered into Microsoft Office Excel 2010.

Result

A total of 140 patients were included in the study, with 59.29% being male and 40% female. The largest proportion of participants was in the age group of over 70 years (29.28%), followed by those aged 51-60 years (22.15%). Ethnically, most respondents were Brahman (25%), followed by Mongolian (21.43%). Geographically, 65.72% of participants were from urban areas, while 34.28% came from rural areas.

Table 1: Socio-demographic characteristics of patients (n=140)

Characteristics	Number (%)
Age groups (Years):	
21-30	08 (05.71%)
31-40	16 (11.42%)
41-50	16(11.42%)
51-60	31 (22.14%)
61-70	28 (20%)
More than 70	41 (29.28%)
Gender:	
Male	83(59.29%)
Female	57(40.71%)

Among the 140 patients, the majority were admitted for Respiratory Tract Infections (n=47, 33.58%), followed by Gastrointestinal Infections (GI) (n=38, 27.15%), and Cyst-related issues (n=13, 9.29%).

Table 2: Diagnosis of the patient prescribed with antimicrobial drugs (n=140)

Diagnosis	Number of Patients (%)
Respiratory Tract Infections (RTI)	47 (33.58%)
Gastrointestinal Infections (GI)	38 (27.15%)
CVS	13 (09.29%)
Renal	11 (7.85%)
CNS	09 (06.42%)
Blood	09 (06.42%)
Poisoning	07 (05%)
Endocrine	06 (04.29%)

Figure 1 demonstrated that the most frequently prescribed drug categories were antimicrobials (430 prescriptions, 29.28%), respiratory system medications (210 prescriptions, 14.30%), and gastrointestinal drugs (207 prescriptions, 14.10%), followed by cardiovascular, renal, blood medications, and vitamins, minerals, and dietary supplements (142 prescriptions, 9.67%). On average, each patient was prescribed 10.49 medications, and the average cost of medicines per prescription was NRS 9,149.89 and average costs of antibiotics per prescriptions were NRS 5869.32. Total cost of prescribed antibiotics was NPR 821704.8.

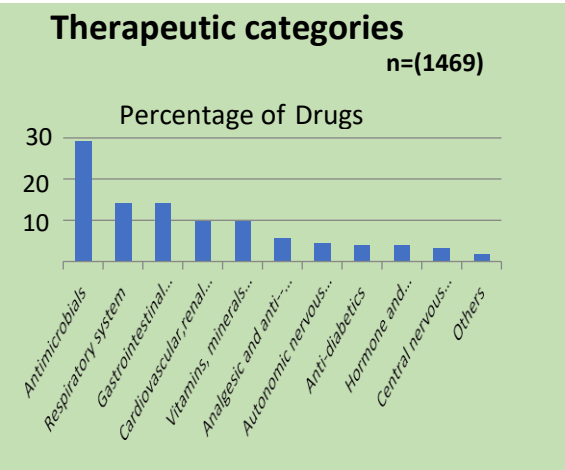

Figure 1: Therapeutic classification of prescribed medication (n=1469)

In table no 3, Shows that injection dosage form was commonly used followed by oral route. Mostly prescribed injectable antibiotic were Beta-lactam inhibitors third generation cephalosporins group drug(ceftriaxone) (16.27%), piperacillin & tazobactam (13.48%) followed by fluroquinolones group drug levofloxacin (11.39%) and glycopeptides meropenam (7.20%).

Table 3: Distribution of Antimicrobial agents based on Therapeutic Classifications (n=430)

Therapeutic Classification		Dosage form		No. of drug	Percentage
		Oral	Inj.		
Penicillin	Flucloxacillin	-	13	13	03.02
Cephalosporin	Ceftriaxone	-	70	70	16.27
B-Lactamase Inhibitor	Piperacillin	-	58	58	13.48
	Tazobactam	-	58	58	13.48
	Meropenam	-	31	31	07.20
Macrolide	Clindamycin	-	06	06	01.39
Aminoglycosides	Amikacin	-	09	09	02.09
	Gentamycin	-	10	10	02.32
Glycopeptides	Vancomycin	-	14	14	03.25
	Tiecloplanin	-	18	18	04.18
Fluroquinolone	Ciprofloxacin	-	02	02	0.46
	Levofloxacin	-	49	49	11.39
	Nitrofurantoin	11	-	11	02.55
Nitro-imidazole	Metronidazole		08	08	01.86
	Ornidazole		05	05	01.16
Antifungal	Vorniconazole	06	-	06	01.39
Antituberculosis	Rifampicin	03	-	03	0.69
	Ethambutol	05	-	05	01.16
	Pyrizinamide	03	-	03	0.69
	Isoniazide	03	-	03	0.69
Polypeptide	Polymycin-B		04	04	0.93
Tetracycline	Doxycycline	06	-	06	01.39
Oxazolidiones	Linizolid		29	29	06.74
Antibiotics	Rifaximin	06	-	06	01.39
Antiviral	Acyclovir		03	03	0.69

In table no 4, shows that ceftriaxone was the most frequently used antibiotic with 25.58 DDD per 100 bed-days, followed by levofloxacin at 6.03 DDD/100 bed-days and piperacillin/tazobactam at 5.30 DDD/100 bed-days.

Table 4: Pattern of Utilization of Antibiotic (n=390)

Antibiotic	ATC Code	DDD	Study duration	Occupancy Index	DDD/100 beds days
Tazobactam (IV)	J01CR05	14			5.30
Amikacin(iv)	J01GB06	1			1.79
Ceftriaxone(iv)	J01DD04	2			25.58
Ciprofloxacin(iv	J01MA02	0.5	90 days	0.81	3.65
Clindamycin(iv	J01FF01	1.8			3.35
Doxycycline(iv)	J01AA02	0.1			3.57
Flucloxacillin(iv)	J01CF05	2			0.91
Gentamycin(iv)	J01GB03	0.24			0.30
Levofloxacin(iv)	J01MA12	0.5			6.03
Linezolid(iv)	J01XX08	1.2			2.12
Meropenam(iv)	J01DH02	2			3.27
Teicoplanin(iv)	J01XA02	0.4			2.97
Vancomycin(iv)	J01XA01	2			3.77
Nitrofurantoin (O)	J01XE01	0.2			0.46
Piperacillin (iv)	J01CR05	14			5.30
Polymyxin B(iv)	A07AA05	3			0.01
Rifaximine (iv)	A07AA11	0.6			4.88

Discussion

At present study more number of participants was male 83(59.29%) and 57(40.71%). Similar study was conducted by Ghimire R, Shrivastava RK. in Nepal found 123(61.5%) male and 77(38.5%) were female.[4] Demographic characteristics showed that percentage of male suffering was more than females. More number of patients were male, similar to the findings of Gajbhiya VP et al., who reported that 45 (70%) of the participants were male and 20 (30%) were female[13] among patients receiving antimicrobial agents in the ICU of a rural tertiary care hospital. The most likely explanation for this finding is that men have easier access to medical facilities than women, who are sometimes unwilling to use them even when they are really ill, especially if they are from lower socioeconomic backgrounds. Out of the 140 patients admitted in Medical ICU, Respiratory infection were 33.58%, GIT 27.15%, Cardiac 9.29%, Genito urinary and Renal 7.85%, CNS and Blood 6.42%, Poisoning 5%, and Endocrine 4.29%. Similar study were conducted by Luitel, A, More drug prescribed for respiratory tract infection (21.7%), and GIT infections (15.3%).[14] Another study conducted by Mathur P et al. in India indicated that secondary bacteremia in their ICUs was primarily caused by lower respiratory tract (LRT) infections, which aligns with the findings of this study.[15]

The most commonly prescribed antibiotics were from the Beta-lactam cephalosporin group, with ceftriaxone 70 (16.27%) and piperacillin and tazobactam 58 (13.48%), followed by fluoroquinolones such as levofloxacin 49 (11.39%) and glycopeptides like meropenem 31 (7.20%). Our study also revealed a higher frequency of parenteral administration compared to the oral route, with combination parenteral antibiotics being the most commonly used. A study conducted in Uganda found that about 48% of antibiotics used were injectable dosage form.[16] Another study on AMAs utilizations in ICU conducted in Nepal suggested that 45.2% of piperacillin and tazobactam combination antibiotic used were paternal dosage form, followed by ceftriaxone 34.4%.[5] Another similar study conducted in Nepal found that most commonly utilized antibiotic was piperacillin/tazobactam (45.2%), followed by ceftriaxone (34.4%).[17] In our study most utilized antibiotic was ceftriazoxne, followed by pipercilli and tazobactam which less value than two above study of Nepal. The preference for injectable medications may be linked to the need for rapid onset of action, which is essential for treating critically ill patients in ICU. In comparison to other antibiotics, ceftriaxone was prescribed more often in our study, largely because of its affordability and effectiveness. Cephalosporins are often recommended for their relatively low toxicity and broad-spectrum activity. The third-generation Beta-lactam cephalosporin, with its wide antibacterial coverage, as well as its safety profile and lower cost, likely contributed to ceftriaxone being prescribed more frequently than other antibiotics in our research. As a result, ceftriaxone became the preferred choice, often used in combination with other medications.

Rational drug use occurs when patients are prescribed medications that align with their clinical needs, at doses tailored to their individual requirements, for an appropriate duration, and at

the minimum cost to both the patient and society. Treatment cost plays a significant role in the prudent use of medications. In a developing country like Nepal, ensuring patients adhere to their prescribed therapies is vital. The DDD refers to the estimated average daily maintenance dose for the primary indication in adults.[18] When considering inpatient drug use, the DDDs per 100 bed days may be used. A bed day may be defined differently in different hospitals or nations. A bed day is typically defined as a day when a patient is confined to a bed and spends the night in the hospital. One bed day is occasionally included and occasionally deleted when calculating the number of day cases (patients entered for a procedure or operation in the morning and released before the evening). When conducting comparison studies, bed days should always be defined uniformly. This metric is used in assessments of drug use in hospitals. This indicator is quite helpful for comparing hospitals to one another. Ceftriaxone was the most utilized antibiotic in our study, with a consumption rate of 25.58 DDD per 100 bed-days, followed by levofloxacin (6.03 DDD/100 bed-days) and piperacillin/tazobactam (5.30 DDD/100 bed-days). A similar study conducted by Shankar PR et al. reported antibiotic consumption in terms of DDD per 100 bed-days, with penicillins accounting for 55.1, followed by fluoroquinolones (5.34), second-generation cephalosporins (0.82), and third-generation cephalosporins (13.74), respectively.[3] Another study conducted by Patel SR on antimicrobial utilization in India found that ceftriaxone DDD/100 bed-days were 11.86.[19] Utilization of ceftriaxone were high. In this study, the DDD value for ceftriaxone was 25.58, indicating a higher rate of consumption in our setting compared to international standards. The WHO recommends using the ATC/DDD classification system as a standard tool in drug utilization research to promote more rational and effective drug use.

One of the limitations is sampling method. we follow the purposive sampling rather than randomization. Since the study is monocentered so this could not represent the data of whole country.

Conclusion

Most common antibiotics were ceftriaxone,piperacillin & tazobactam followed by fluroquinolones group drug levofloxacin and glycopeptides meropenem. In our study we found that ceftriaxone (J01DD04) 25.58 DDD/100 bed-days followed by levofloxacin (J01MA12) 6.03 DDD/100 bed-days, and piperacillin/tazobactam (J01CR05) 5.30 DDD/100 bed-days. Our study demonstrates the high uses of antibiotics in the hospital which is nearly 65 percent cost of total medicine.

Recommendation

Our study recommends that the hospital develop guidelines for antibiotic use and establish treatment protocols to ensure long-term patient safety. The findings suggest that, to enhance antibiotic use in these healthcare settings, an antibiotic stewardship program should be initiated without delay.

Conflict of interest

The authors declare that they have no conflict of interests.

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