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ОРИГИНАЛЬНОЕ ИССЛЕДОВАНИЕ

Antibiotic use density in trauma intensive care unit at a tertiary care hospital in Western Rajasthan

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Abstract. *Relevance*. The excessive use of antibiotics is a public health issue that has hampered poor and middle-income nations and is linked to rising healthcare expenses and antimicrobial resistance, which is regarded as an important risk to world health. In addition, resistance raises expenses, prolongs hospital stays for patients, and causes mortality. Defined daily dose (DDD) represents the average adult daily maintenance dose of a specific drug applied according to its primary indication. Antibiotic use density is expressed as defined daily doses/ 100 patient- days. *Aim*. The aim of this study is to evaluate the pattern of usage of antibiotics and to find out antibiotic use density in trauma intensive care unit (ICU). *Materials and Methods*. In this prospective observational study prescription data of 100 consecutive patients at admission into the trauma ICU was audited. Patients of all age of either gender admitted in the trauma ICU during the study period, which have been prescribed with antibiotics. The study was conducted over a period of eight months from August 2022 March 2023. During this period, all the included patients were followed up for their entire duration of stay in trauma ICU. *Results and Discussion*. The prescriptions of 100 consecutive patients admitted into the ICU were analyzed. On analyzing co- morbidities it was noted that 79% were affected with contusions in brain/ intracerebral hemorrhage/ subdural hematoma followed by 5% with pnumothorax. According to DDD/100 bed days in our study piperacillin+tazobactam (10.64), cefoperazone+sulbactam (5.21), amikacin (7.5), vancomycin (3.2) and linezolid (3.2) were most consumed drugs in trauma ICU patients. *Conclusion*. Present study results conclude that overuse of antibiotics can cause antibiotic resistance, increased duration of stay in hospitals and reason of mortality.

Key words: antibiotics use density, trauma ICU, antibiotics resistance

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Conflict of interest statement. The authors declare no conflict of interest.

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Introduction

Increasing healthcare costs and antimicrobial resistance, which is considered a major threat to global health, are associated with the overuse of antibiotics, a public health problem that has plagued low- and middle-income countries [1]. Antibiotic resistance is partly caused by hospitals' overuse of antibiotics [2]. Furthermore, resistance results in increased costs, longer hospital stays for patients, and increased mortality [3]. By using evidence-based strategies, antibiotic resistance can be decreased [4]. Over time, the pattern of antimicrobial resistance (AMR) shifts, differing between nations and even within hospitals in the same nation [5]. The intensive care unit (ICU) consumes much more antibiotics overall than ordinary hospital wards, despite the fact that antibiotics are one of the most often given medication classes among all hospitalized patients [6]. There is ample evidence that up to 50% of antibiotic prescriptions are given incorrectly, despite several recommendations from governmental and professional organizations [7]. Monitoring and assessing the use of antibiotics in the intensive care unit on a regular basis is crucial. The defined daily dose (DDD) and the anatomical therapeutic chemical (ATC) categorization system are highly recommended by the World Health Organization (WHO) as a measuring unit for medication usage research [8]. The average adult daily maintenance dose of a particular medication administered in accordance with its principal indication is known as the defined daily dose, or DDD. The formula for density is defined daily dosages per 100 patient days. The aim of this study is to evaluate the pattern of usage of antibiotics and to find out antibiotic use Density in trauma ICU.

Materials and methods

This prospective observational research was conducted using the Case Sheets of patients who were admitted to the trauma intensive care unit between August 2022 and March 2023. This study was carried out in the Dr. S.N. Medical College and Hospital's pharmacology department in Jodhpur. When 100 consecutive patients were admitted to the trauma intensive care unit, their prescription data was audited. The study comprised patients of any age, male or

female, who were admitted to the trauma intensive care unit during the study period, had been administered antibiotics, and were willing to participate. Patients who were not provided antibiotics and who did not meet the WHO's definition of a medication usage study were not included.

All of the enrolled patients were monitored throughout this time for the length of their trauma intensive care unit stay. All patients' initial demographic information, including name, age, gender, hospital number, and clinical diagnosis, was documented. Additional factors were recorded, including the total number of medications administered during the hospital stay, the ailment for which the patient was hospitalized, the length of the intensive care unit stay, mortality, and the total number of antibiotics provided. The medications that were prescribed while the patient was in the intensive care unit were recorded. The Anatomical Therapeutic Chemical (ATC) categorization method (ATC/DDD version 2010) was used to categorize the medications [8].

Prescribing Indicators:

1) The average number of medications per prescription was calculated by dividing the total number of prescriptions written for the various medicines under study.

2) The proportion of pharmaceuticals supplied under the generic name was determined by dividing the number of prescriptions for generic drugs by the total number of medications administered, and then multiplying the result by 100.

3) The percentage of prescriptions that contained an injection was calculated by dividing the number of patient interactions during which an injection or antibiotic would be given by the total number of surveys. The result was then multiplied by 100.

4) The percentage of drugs provided from the National List of Essential Medicines (NLEM) 2022 was calculated by dividing the number of medications from the hospital's essential medicine list.

The following formula was used to compute the antibiotic use density (AD), which was given as DDD/100 patient-days (DDD100) [9].

AD = drug consumption in the study period (Gm)× × 100 / DDD (Gm) x study period x bed strength× × avg. occupancy

Statistical analysis: Mean ± SD was used to express the data. A Microsoft Excel sheet was used to enter all of the data into a master chart, after which it was statistically analyzed. SPSS software was used for all of the analyses. P-values less than 0.05 were regarded as statistically significant.

Results and discussion

One hundred consecutive patients who were hospitalized to the trauma intensive care unit had their prescriptions examined. There were 25 female patients and 75 male patients. The majority of patients admitted to the trauma intensive care unit were between the ages of 35 and 65 (Table 1). Antimicrobial resistance may be driven differently in rural regions. Because fewer healthcare facilities are available, there may be less access to antibiotics overall, yet abuse can still happen because people are unaware of how to use them properly. Antibiotics are frequently sold over-the-counter in India without a prescription; this practice may be especially prevalent in rural regions with inadequate access to healthcare [10].

The number of antibiotics prescribed was compared with gender, age, and length of treatment in the study. It was discovered that the majority of patients received three prescriptions for each antibiotic, which was statistically significant ($P<0.05$) when compared to all groups that received one, two, or more than three prescriptions. In a similar vein, Priyadharsini et al. discovered that 57% of the population was male and the majority of the patients were between the ages of 40 and 60 [11].

According to the analysis of the research population's co-morbidities, 79% of the participants had head contusions, intracerebral hemorrhages, or subdural hematomas, while 5% had pneumothorax (Table 2). According to the analysis of the research population's co-morbidities, 79% of the participants had brain contusions, intracerebral hemorrhages, or subdural hematomas, while 5% had pnumothorax.

According to earlier research, the other reasons for admission in a study were head damage (32.39%), difficult instances of acute abdomen (25.35%), and cardiovascular problems (21.94%) [12]. Information about trauma due to factors including poverty, education, political and religious beliefs, and a nation's geographic and economic trends, ICU admissions vary from one center to another [13].

Table 1

Demographical distribution of patients according to the number of antibiotics prescribed in trauma ICU

Demographic Data		N	No. of Antibiotics				p-value
			1 Antibiotics	2 Antibiotics	3 Antibiotics	> 3 Antibiotics	
Gender	Male	75	13	14	45*	3	P<0.05
	Female	25	1	6	16*	2	
Age	< 35	32	6	6	19*	1	P<0.05
	35–65	54	6	11	33*	4	
	> 66	14	2	3	9	0	
Duration of stay	< 6 days	41	6	7	24*	4	P<0.05
	6–10 days	28	5	7	16*	0	
	> 10 days	31	3	6	21*	1	

Note: P<0.05 (Z test) is considered significant.

Table 2

Co-morbid conditions of patients on admission in trauma ICU

№	Disease Condition	No. Of patients (%), *n* = 100
1	Acute febrile illness	1
2	Anti- nuclear antibody	1
3	Biliary tract cancer	1
4	Contusion in Brain/ICH /SDH	79
5	Cardiac arrest	1
6	Cervical injury	1
7	Cranioplasty	1
8	Facial nerve palsy	1
9	Gall bladder surgery	1
10	GI obstruction	1
11	Intestinal obstruction	1
12	Nephrolethotomy	1
13	Peritionities	1
14	Pneumothorax	5
15	Postpartum hemorrhage	1
16	Septic arthritis	1
17	Seizure	1
18	Superior orbital fissure	1

Note: ICH — intracerebral hemorrhage; SDH- subdural hematoma; GI- gastrointestinal.

The mortality rate was 54% in trauma intensive care unit. 46% patients were transferred to different wards of the hospital (Table 3). The average duration of stay in trauma ICU was 8.58 days and average number of drugs prescribed was 8.98. The average duration of antimicrobials including all prescribed antibiotics to 100 traumas ICU patients was 5.91. The average length of stay for patients in a U.S. research was 5.2 ± 9.8 days, and the overall death rate was 33% [14]. 8.58 days was the average length of stay in the trauma intensive care unit, and 8.98 medications were provided on average. For 100 trauma ICU patients, the average duration of antimicrobials, including all given medicines, was 5.91. In a study reported from a trauma ICU, mean ± SD number of drugs was 9.1 ± 6.5 [15]. In another study the number was 12.1 ± 7.6 [14]. The average number of drugs should be kept as low as possible to minimize the risk of drug interactions, development of bacterial resistance and hospital costs [16].

Table 3

Patients characteristics and drugs prescription

Patients Characteristics	TICU (*n* = 100)
Mortality	54
Mortality before 07 days	29
Mortality after 07 days	25
Transfer to ward	46
Average duration of stay in ICU (Mean ± SD)	8.58±6.21
Average no. of drugs prescribed (Mean ± SD)	8.98±2.80
Average duration of antimicrobial agents (Mean ± SD)	5.91±1.66

Note: TICU- trauma intensive care unit; ICU- intensive care unit; SD- standard deviation.

We have expressed the frequency of medication prescriptions using the DDD/100 bed-days technique and the ATC categorization. We have determined DDDs for the medications given to trauma intensive care unit patients. The medication use metric that we have employed is the DDD per 100 bed days (Table 4). Because of the 100% occupancy rate during the trial, the occupancy index in the DDD/100 bed-days computation was 01. In grams, the DDD dosage and ATC code of each antibiotic or combination were obtained from the WHO ATC/DDD Toolkit, which is accessible on the authorized website www.atcddd.fhi.no. Except for cotrimoxazole, every antibiotic was administered intravenously. The sum of all prescribed units times the antibiotic's potency in grams was used to determine each antibiotic's total dosage.

In our analysis, the most often used medications among trauma intensive care unit patients were piperacillin+tazobactam (10.64), cefoperazone+sulbactam (5.21), amikacin (7.5), vancomycin (3.2), and linezolid (3.2) based on DDD/100 bed days. However, according to a research, penicillins with beta-lactamase inhibitors were the most often utilized class of antibiotics, followed by quinolones and second-generation cephalosporins [17, 18]. meropenem, ceftriaxone, and amoxicillin clavulanate consumption in ddd / 100 Bed days were 61.41, 24.24, and 10.91 in another investigation [19]. With their ever-increasing use and misuse, microorganisms have developed antimicrobial resistance in India and worldwide. *Klebsiella pneumoniae's* imipenem susceptibility dropped from 65% in 2016 to 43% in 2021, according to the Indian Council of Medical Research's (ICMR) 2021 annual report in India, while *Escherichia coli's* imipenem susceptibility dropped from 86% in 2016 to 64% in 2021 [20]. A study done by Sharma et al. also found that the sensitivity of *Klebsiella pneumoniae* to meropenem decreased from 15% in 2018 to 2.5% in 2022, while the sensitivity of *Klebsiella* to colistin decreased from 96% in 2018 to 28% in 2022 [21]. The

incidence and prevalence of antimicrobial-resistant-bacterial infections has attained incongruous levels during 21st century and threatens global public health as a silent pandemic, necessitating urgent interventions [22, 23]. One significant factor affecting patient mortality and morbidity is bacterial resistance to medications. A number of variables, such as the severity of the disease, the requirement for extended hospitalization, and the frequent use of broad-spectrum antibiotics, are linked to the formation and spread of bacterial resistance in intensive care units.

Table 4

Antibiotic use density according to DDD/100 patient-days along with ATC code in trauma ICU

S.N.	Antibiotics	ROA	ATC CODE	DDD (gm)	DDD/100 Bed Days
A.	**Group-Beta lactamase**				
i.	Cephalosporin				
1	Cefixime	IV	J01DD08	0.4	0
2	Ceftazidime	IV	J01DD02	4	0.32
3	Cefotaxime	IV	J01DD01	4	0.57
4	Ceftriaxone	IV	J01DD04	2	2.10
5	Cefepime+Tazobactam	IV	J01DE01	4	0.48
6	Cefoperazone+Sulbactam	IV	J01DD62	4	5.21#
ii.	Penicillin				
1	Amoxicillin+clavulanic acid	IV	J01CR02	3	0.72
2	Piperacillin+Tazobactam	IV	J01CR05	14	10.64#
3	Ticarcillin+ Clavulanicn Acid	IV	J01CR03	15	0.25
iii.	Carbapenems				
1	Meropenem	IV	J01DH02	3	2.42
2	Imipenem+Cilastatin	IV	J01DH51	2	1.76
iv.	Monobactam				
1	Aztreonam	IV	J01DF01	4	1.14
v.	Sulfonamides				
1	Cotrimoxazole	IV	J01EE01	4	0.17
B.	**Group- Macrolide**				
1	Azithromycin	Oral	J01FA10	0.3	0
i.	Fluro- Quinolone				
1	Levofloxacin	IV	J01MA12	0.5	1.05
2	Ciprofloxacin	IV	J01MA02	0.8	0.24
C.	**Group-Aminoglycoside**				
1	Amikacin	IV	J01GB06	1	7.5#
2	Clindamycin	IV	J01FF01	1.8	6.17
D.	**Group-Nitroimidazole**				
1	Metronidazole	IV	J01XD01	1.5	1.30

Ending tabl. 4

S.N.	Antibiotics	ROA	ATC CODE	DDD (gm)	DDD/100 Bed Days
E.	**Anti-Viral**				
1	Remedsvir	IV	J05AB16	0.1	0
F.	**Group- Others**				
1	Vancomycin	IV	J01XA01	2	3.22#
2	Teicoplanin	IV	J01XA02	0.4	1.63
3	Rifampicin	IV	J04AB03	0.6	0
4	Linezolid	IV	J01XX08	2	3.29
5	Polymyxin B	IV	J01XB02	0.15	2.93

Note: ROA – root of administration; ATC – anatomical therapeutic chemical; DDD- defined daily dose.

Conclusion

The current study's findings indicate that excessive antibiotic usage can lead to antibiotic resistance, longer hospital stays, and higher death. The institution's antimicrobial policy should be rigorously applied on a regular basis, with a committee participating to ensure the availability of standard treatment regimens and to monitor prescription trends.

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Частота использования антибиотиков в отделении интенсивной терапии травматологического профиля в многопрофильной больнице в Западном Раджастане

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Аннотация. *Актуальность*. Чрезмерное использование антибиотиков является проблемой общественного здравоохранения, которая наносит ущерб бедным и средним странам и связана с ростом расходов на здравоохранение и антимикробной резистентностью, которая рассматривается как важный риск для здоровья населения во всем мире. Кроме того, резистентность увеличивает расходы, продлевает пребывание пациентов в больнице и приводит к смертности. Определенная суточная доза (ОСД) представляет собой среднюю суточную поддерживающую дозу конкретного препарата для взрослых, применяемую в соответствии с его основным показанием. Плотность использования антибиотиков выражается как определенные суточные дозы/100 пациенто-дней. *Цель*. Цель данного исследования — оценить характер использования антибиотиков и определить частоту их применения в отделении интенсивной терапии травматологических больных (ОИТТ). *Материалы и методы*. В этом проспективном обсервационном исследовании были проанализированы данные о назначениях антибиотиков 100 пациентам, последовательно поступившим в ОИТТ травматологических больных. В исследование были включены пациенты всех возрастов и обоих полов, поступившие в ОИТТ в течение периода исследования, которым были назначены антибиотики. Исследование проводилось в течение восьми месяцев, с августа 2022 по март 2023 года. В течение этого периода все включенные пациенты наблюдались на протяжении всего периода пребывания в ОИТТ. *Результаты и обсуждение*. При анализе сопутствующих заболеваний было отмечено, что у 79% пациентов наблюдались ушибы головного мозга/внутримозговое кровоизлияние/субдуральная гематома, а у 5% — пневмоторакс. Согласно данным ОСД/100 койко-дней, в нашем исследовании наиболее часто используемыми препаратами у пациентов травматологического отделения интенсивной терапии были пиперациллин+тазобактам (10,64), цефоперазон+сульбактам (5,21), амикацин (7,5), ванкомицин (3,2) и линезолид (3,2). *Выводы*. Результаты настоящего исследования показывают, что чрезмерное использование антибиотиков может привести к развитию антибиотикорезистентности, увеличению продолжительности пребывания в больнице и повышению смертности.

Ключевые слова: плотность использования антибиотиков, травматологическое отделение интенсивной терапии, антибиотикорезистентность

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