Section: Pharmacology

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STUDY OF ANTIBIOTIC CONSUMPTION AND BACTERIAL RESISTANCE PATTERNS AMONG ICU PATIENTS IN A TERTIARY CARE HOSPITAL

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Corresponding Author:
Durga Prasad Peddineni,

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Durga Prasad Peddineni[1], K. Chandrakala[2], Prasanthi Kolli[3], Suraiya Khan[4]

[1]PhD Scholar, Department of Pharmacology, Guntur Medical College and Hospital, Guntur, Andhra Pradesh, India.
[2]Professor and Head, Department of Pharmacology, Government Medical College, Ongole, Andhra Pradesh, India.
[3]Professor and Head, Department of Microbiology, Government Siddhartha Medical College, Vijayawada, Andhra Pradesh, India.
[4]Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA.

ABSTRACT

Background: Antimicrobial resistance and variable antibiotic exposure complicate treatment in intensive care units (ICUs). Local surveillance of bacterial isolates and antibiotic consumption can inform stewardship activities. **Objective:** To estimate monthly antibiotic consumption, culture-positive specimen sources, bacterial isolate distribution and recorded antimicrobial resistance patterns in a tertiary-care adult ICU setting. **Materials and Methods:** This prospective observational surveillance study covered January–December 2024 and included 250 non-duplicate culture-positive bacterial isolates. Specimen and organism distributions and recorded resistant-isolate counts were summarised descriptively. Antibiotic consumption data were obtained from the central pharmacy and categorized according to the WHO AWaRe classification and expressed as DDD/100 bed-days. Monthly antibiotic-consumption charts were examined. **Results:** Urine accounted for 98/250 (39.2%) specimens, followed by pus (60/250; 24.0%) and blood (44/250; 17.6%). Escherichia coli was the leading isolate (68/250; 27.2%), followed by Pseudomonas spp. (39/250; 15.6%), Klebsiella pneumoniae (38/250; 15.2%), and K. oxytoca (32/250; 12.8%). Recorded resistant-isolate counts included 37 E. coli observations for ciprofloxacin and 29 Pseudomonas observations for ceftazidime. Access antibiotic utilization remained substantially below the WHO target of > 60%. The penicillin chart showed a prominent October peak for amoxicillin–clavulanic acid and a November increase for piperacillin–tazobactam. Ceftriaxone predominated in the cephalosporin chart during most months. Amikacin exceeded gentamicin throughout the aminoglycoside chart, while meropenem increased sharply during October–December among the other antibiotics. **Conclusion:** Watch category antibiotics dominated prescribing practices in adult ICU's, While Access antibiotic use remained considerably below WHO recommendations. Gram-negative organisms predominated among culture-positive ICU specimens, and recorded resistance involved multiple antibiotic groups. Monthly consumption charts demonstrated distinct class-specific fluctuations, supporting regular prescribing audits and local microbiological surveillance.

INTRODUCTION

Antimicrobial resistance (AMR) threatens effective treatment of common and severe infections. In hospitals, delayed active treatment can worsen clinical outcomes, while unnecessary antimicrobial exposure selects for organisms that are difficult to treat. Intensive care units face both problems because patients often have severe illness, invasive devices, repeated antibiotic courses and prolonged exposure to the healthcare environment. The global burden analysis by Murray and colleagues estimated a major contribution of bacterial AMR to deaths worldwide in 2019.[1] A later analysis showed that the burden has

persisted over several decades and may continue to grow without effective prevention and treatment.[2]

Antibiotic prescribing in critical care must balance urgency with diagnostic uncertainty. Broad empirical treatment may be justified for life-threatening infections, but it should be reviewed when culture and susceptibility results become available. The Surviving Sepsis Campaign recommends prompt effective therapy for sepsis and septic shock together with continuing reassessment and de-escalation when appropriate.[3] Local laboratory data are particularly important because the prevalence of resistant organisms varies between hospitals and clinical units. India faces a substantial AMR burden. Surveillance of clinically important Gram-negative organisms has identified resistance to cephalosporins, fluoroquinolones and carbapenems as important treatment challenges. Hospital-level patterns may differ from national aggregates because of differences in case mix, referral pathways, laboratory testing and infection prevention. The Indian Council of Medical Research surveillance network provides national context, but individual ICUs still require cumulative antibiograms based on appropriately selected isolates.[4]

Antimicrobial consumption is a related but distinct surveillance domain. The World Health Organization (WHO) Anatomical Therapeutic Chemical/defined daily dose (ATC/DDD) system provides a standard unit for describing medicine use.[5] Consumption can be reported as DDD per 100 occupied bed-days when the amount of drug used and occupied bed-day denominator are available. The WHO Access, Watch and Reserve (AWaRe) classification helps stewardship teams examine prescribing patterns and identify antibiotics requiring particular oversight.[6,7]

Resistance surveillance also requires careful denominators. The proportion resistant to a given drug should use the number of eligible isolates actually tested against that drug, not all isolates cultured in the ICU. Similarly, the internationally proposed definition of multidrug resistance (MDR) is non-susceptibility to at least one agent in three or more antimicrobial categories, with organism-specific intrinsic resistance considered.[8-10] A simple count of resistant classes may be useful descriptively but does not automatically establish this standardised MDR definition.

This study describes one year of adult ICU antibiotic consumption, surveillance to describe specimen sources, pathogen distribution and recorded antimicrobial resistance. Its purpose is to report the available observations without overstating the precision of resistance estimates or claiming an unmeasured relationship between consumption and resistance.

MATERIALS AND METHODS

Study design and setting: A prospective observational surveillance study was conducted in adult ICUs at Government General Hospital, Guntur, Andhra Pradesh, India, between January and December 2024. The study was performed to evaluate antibiotic consumption patterns using the WHO AWaRe classification system and also this study analysed aggregate microbiological surveillance findings. The ethical approval and consents were taken.

Study population: The microbiological dataset comprised 250 non-duplicate bacterial isolates from adults aged 18 years or older with positive cultures and recorded antibiotic treatment. Repeated isolates and organisms considered contaminants, colonisers or commensals were excluded.

Microbiology: Clinical specimens were processed by the hospital microbiology laboratory. Antimicrobial susceptibility was assessed by disk diffusion, and results were analysed using WHONET.

Antibiotic consumption: Data regarding antibiotic utilization of adult ICU's were collected from the hospital central pharmacy. Monthly antibiotic-consumption charts for January–December 2024 from all adult ICU's were compiled. Antibiotics were categorized according to the WHO AWaRe classification and Anatomical Therapeutic Chemical (ATC) system. Antibiotic consumption was quantified using the WHO Defined Daily Dose (DDD) methodology and expressed as DDD per 100 bed-days.

Statistical analysis: Data were entered into Microsoft Excel and summarized using descriptive statistics. Monthly variations in antibiotic consumption were analysed using one-way analysis of variance (ANOVA). Frequencies and percentages were calculated using the appropriate available denominators. No consumption–resistance correlations were generated because the aggregate data lacked the necessary observations and tested denominators. Descriptive comparisons with published literature were interpreted cautiously.

RESULTS

1.Antibiotic consumption patterns

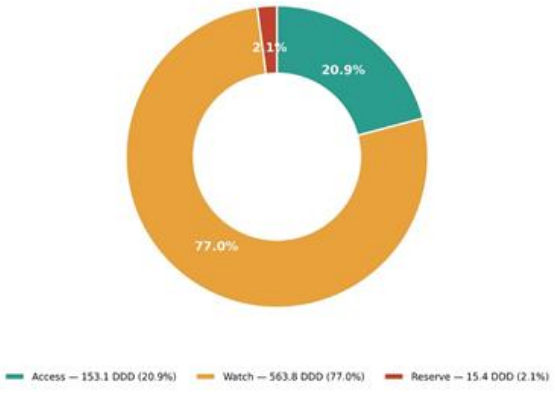


Figure 1: WHO AWaRe Classification of ICU Antimicrobial Consumption, Adult ICU, 2024, DDD/100 Bed days

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Figure 1 analysis of antibiotic consumption from January 2024 -December 2024 revealed marked predominance of Watch category antibiotics accounted for 77.0%, Access antibiotics represented 20.9% and Reserve antibiotics contributed 2.1% of the total antibiotic consumption.

1.2 Antibiotic-specific consumption

Table 1: Monthly trends of antibiotic consumption DDD/100 bed days at the tertiary care facility

Antibiotics	AWaRe Category	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total DDD/100 bed-days
AMPICILLIN 500mg	Access	0.123	0.22	0.175	0	0.065	0.208	0.137	0.131	0.071	0.415	1.274	1.657	4.476
AMOXYCILLIN-CLAVULONIC ACID 1.2 g	Access	2.631	1.687	1.816	2.36	2.71	2.493	2.466	2.834	3.806	14.174	3.402	2.323	42.708
PIPERACILLIN - TAZOBACTAM 4.5 g	Watch	5.443	7.118	7.064	9.376	7.535	6.945	5.126	3.719	4.729	1.622	10.419	5.963	75.047
CEFUROXIME 1.5g	Watch	0	0	0.21	0	0	0	1.233	0.645	0	0	0	0	2.088
CEFOTAXIME 1g	Watch	5.599	0.22	0.525	0.602	1.071	0.935	1.188	0.787	6.69	1.329	5.256	1.2730	25.475
CEFOPERAZONE-SULBACTUM 1.5g	Watch	5.549	6.459	8.456	5.765	5.899	6.544	8.971	9.15	6.976	2.132	3.727	1.396	71.024
CEFTRIAXONE 1g	Watch	20.552	32.295	32.033	36.107	32.554	26.384	36.469	31.877	24.465	2.025	6.728	18.377	299.866
GENTAMYCIN 80mg	Access	0.822	0.439	0.617	0.97	0.779	1.108	0	0.84	1.529	0.104	1.274	1.061	9.543
AMIKACIN 500mg	Access	10.136	6.679	8.635	7.687	4.206	3.74	8.262	5.431	5.904	7.282	9.27	10.342	87.574
LEVOFLOXACIN 500mg	Watch	0.164	0.527	0.336	1.978	0.156	0.332	0	0.157	0	0.234	0.382	0	4.266
MEROPENEM 1g	Watch	5.656	4.435	5.252	1.573	6.713	4.46	5.667	4.78	1.421	8.78	11.493	13.18	73.41
AZITHROMYCIN 500mg	Watch	0	0.035	0.168	0	0.156	0.166	0	0	0	0.156	0	0	0.681
CLINDAMYCIN 300mg	Access	0.452	0.41	0.664	0.609	0.779	1.053	1.096	0	0.142	0.418	0.908	2.228	8.759
VANCOMYCIN 1g	Watch	0.288	1.318	0.42	0.673	2.375	0.54	0.164	0.142	0.323	2.336	1.453	1.909	11.941
LINEZOLID 600mg	Reserve	0.954	1.327	1.093	0.881	0.841	0.765	1.71	1.59	0.841	1.682	1.844	1.854	15.382

1.3 Antibiotic class -specific monthly trends

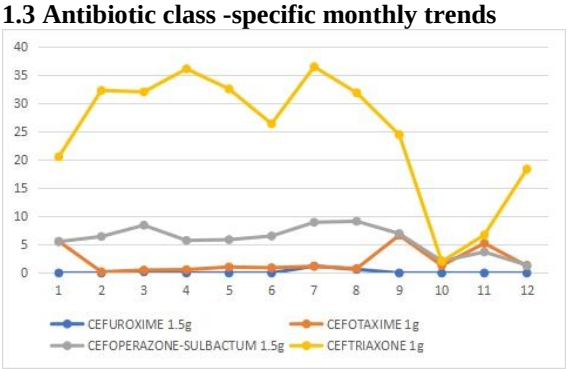


Figure 2: Monthly trends in cephalosporin-class antibiotic consumption (source chart labelled DDD/100), January–December 2024

Third generation cephalosporins constituted the largest proportion of antibiotic consumption with 396.4 DDD/100 bed-days. Figure2 suggests that Ceftriaxone, 3rd generation cephalosporin with 299.866 DDD/100 bed-days accounted for the highest plotted values for much of the year, with peaks in April and July and a decline in October.

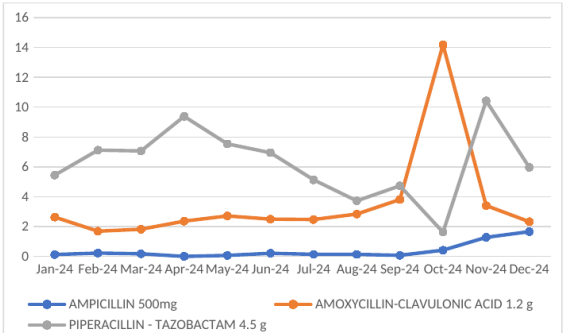


Figure 3: Monthly trends in penicillin-class antibiotic consumption January–December 2024

Penicillin plus β lactamase inhibitor combinations is the second most frequently utilized antibiotic class with 117.8 DDD/100 bed days. Figure3 shows that piperacillin–tazobactam with 75.047 DDD/100 bed-

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days was generally the most prominent penicillin-β lactamase inhibitors group during the earlier months, with a decline in October and a subsequent rise in November. Amoxicillin–clavulanic acid remained comparatively stable for much of the year before a pronounced October peak. Ampicillin was low throughout, with a modest increase during the final months, showing increase in watch category group antibiotic consumption.

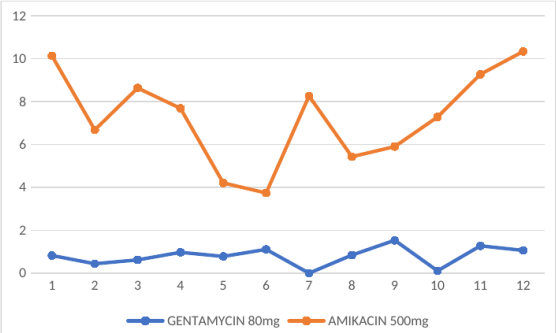


Figure 4: Monthly trends in aminoglycoside-class antibiotic consumption (source chart labelled DDD/100), January–December 2024

Aminoglycoside is the 3rd most frequently used antibiotic class with 97.1 DDD/100 bed-days. Figure 4 shows higher plotted amikacin with 87.574 DDD/100 bed-days consumption than gentamicin with 9.543 DDD/100 bed days in every month. Amikacin declined during May–June, increased in July, and rose again toward November–December. Gentamicin remained at comparatively low levels, with small fluctuations and a peak around September.

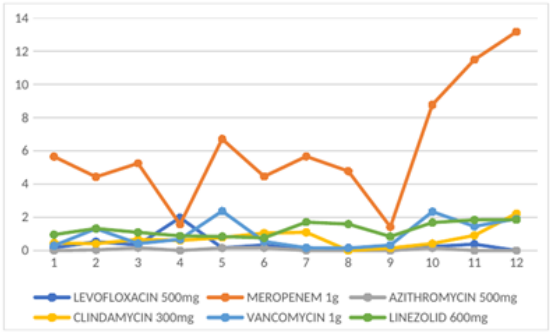


Figure 5: Monthly trends in other antibiotic consumption (source chart labelled DDD/100), January–December 2024

Figure 5 demonstrates that meropenem, which is carbapenem with 73.4 DDD/100 bed-days was the most prominent agent in this group during most months, with a notable decrease in September followed by a sharp increase in October–December. Levofloxacin (Fluoroquinolone), azithromycin (Macrolide), clindamycin (Lincosamide), vancomycin (Glycopeptide) remained at lower plotted levels with intermittent variation. Linezolid(Oxazolidinone), Reserve group antibiotic with 15.382 DDD/100 bed-days showed intermediate variation.

2.Distribution of culture-positive clinical specimens

Table 2: Distribution of culture positive clinical specimens

Specimen	Frequency (n)	Percentage (%)
Brain Fluid	4	1.6
Urine	98	39.2
Pleural Fluid	23	9.2
Ascitic Fluid	10	4.0
Blood	44	17.6
Bile	3	1.2
Pus	60	24.0
Stool	3	1.2
Peritoneal fluid	1	0.4
Aspirated fluid	2	0.8
CSF	2	0.8

Table 2 shows the distribution of 250 culture-positive clinical specimens. Urine constituted the largest proportion, with 98 specimens (39.2%), followed by pus with 60 (24.0%) and blood with 44 (17.6%). Pleural fluid accounted for 23 (9.2%) specimens, while ascitic fluid contributed 10 (4.0%). The remaining specimen categories contributed relatively small proportions, ranging from 0.4% to 1.6%. Urine, pus, and blood collectively represented 80.8% of the culture-positive specimens.

3. Distribution of bacterial isolates

Table 3: Distribution of isolates among clinical specimens

Pathogens	Frequency (n)	Percentage (%)
MRSA	24	9.6
MSSA	27	10.8
Enterococcus	15	6.0
E Coli	68	27.2
K. Oxytoca	32	12.8
K. Pneumonia	38	15.2
Pseudomonas	39	15.6

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Actinobacter	4	1.6
V. Cholera	3	1.2

Table 3 presents the distribution of bacterial isolates recovered from clinical specimens. Escherichia coli was the most frequently identified pathogen, accounting for 68 isolates (27.2%), followed by Pseudomonas with 39 (15.6%), Klebsiella pneumoniae with 38 (15.2%), and Klebsiella oxytoca with 32 (12.8%). Among the Gram-positive organisms, MSSA accounted for 27 (10.8%) isolates, MRSA for 24 (9.6%), and Enterococcus for 15 (6.0%). Actinobacter and V. cholerae were comparatively uncommon, representing 1.6% and 1.2%, respectively.

4. Antimicrobial resistance patterns

Table 4: Antimicrobial Resistance Patterns

Antibiotic	Pathogens n (%)								
	MRSA (n=65)	**MSSA** (n=30)	**Entero Coccus** (n=52)	**E Coli** (n=221)	**K.Oxy** (n=103)	**KPN** (n=113)	**KPS** (n=76)	**AB** (n=7)	**V.C** (n=5)
Cotrimoxazole (	2 (3.1)	1 (3.3)	0 (0)	10 (4.5)	3 (2.9)	5 (4.4)	2 (2.6)	0 (0)	0 (0)
Ampicillin	0 (0)	0 (0)	8 (15.4)	2 (0.9)	2 (1.9)	1 (0.9)	0 (0)	0 (0)	3 (60)
Amoxyclav	0 (0)	0 (0)	2 (3.8)	18 (8.1)	10 (9.7)	17 (15)	2 (2.6)	0 (0)	0 (0)
Gentamycin	6 (9.2)	3 (10)	1 (1.9)	16 (7.2)	4 (3.9)	6 (5.3)	6 (7.9)	0 (0)	0 (0)
Amikacin	0 (0)	0 (0)	0 (0)	8 (3.6)	3 (2.9)	4 (3.5)	0 (0)	0 (0)	0 (0)
High level Gentamycin	0 (0)	1 (3.3)	5 (9.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Doxycycline	3 (4.6)	0 (0)	7 (13.5)	1 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Clindamycin	12 (18.5)	1 (3.3)	10 (19.2)	1 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Nitrofurantoin	0 (0)	0 (0)	0 (0)	7 (3.2)	6 (5.8)	8 (7.1)	0 (0)	0 (0)	0 (0)
Cefaclor	0 (0)	0 (0)	0 (0)	1 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Meropenem	0 (0)	0 (0)	0 (0)	5 (2.3)	6 (5.8)	6 (5.3)	4 (5.2)	0 (0)	0 (0)
Ertapenem	0 (0)	0 (0)	0 (0)	6 (2.7)	5 (4.8)	8 (7.1)	0 (0)	0 (0)	0 (0)
Imipenem	0 (0)	0 (0)	0 (0)	14 (6.3)	8 (7.7)	7 (6.2)	13 (17)	2 (28.6)	0 (0)
Piperacillin + Tazobactam	0 (0)	0 (0)	0 (0)	12 (5.4)	3 (2.9)	2 (1.8)	0 (0)	0 (0)	1 (20)
Cefoxitin	20 (30.7)	2 (6.6)	3 (5.8)	6 (2.7)	1 (0.9)	2 (1.8)	0 (0)	0 (0)	1 (20)
Ceftazidime	0 (0)	0 (0)	0 (0)	10 (4.5)	7 (6.8)	4 (3.5)	29 (38.1)	0 (0)	0 (0)
Cefotaxime	1 (1.5)	1 (3.3)	2 (3.8)	26 (11.8)	12 (11.6)	14 (12.4)	1 (1.3)	2 (28.6)	0 (0)
Ceftriaxone	0 (0)	0 (0)	0 (0)	20 (9)	11 (10.7)	12 (10.6)	2 (2.6)	0 (0)	0 (0)
Cefepime	0 (0)	0 (0)	0 (0)	19 (8.6)	13 (12.6)	9 (7.9)	2 (2.6)	1 (14.2)	0 (0)
Ciprofloxacin	5 (7.7)	5 (16.7)	3 (5.8)	37 (16.7)	7 (6.8)	5 (4.4)	4 (5.3)	2 (28.6)	0 (0)
Erythromycin	13 (20)	15 (50)	10 (19.2)	1 (0.4)	0 (0)	1 (0.9)	0 (0)	0 (0)	0 (0)
Vancomycin	3 (4.6)	1 (3.3)	0 (0)	0 (0)	1 (0.9)	1 (0.9)	0 (0)	0 (0)	0 (0)
Azithromycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Aztreonam	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.9)	0 (0)	10 (13.1)	0 (0)	0 (0)
Linezolid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Capreomycin	0 (0)	0 (0)	1 (1.9)	1 (0.4)	0 (0)	1 (0.9)	1 (1,3)	0 (0)	0 (0)

Table 4 demonstrates variation in recorded antimicrobial resistance among the bacterial pathogens. In the E. coli column, the highest recorded resistant-isolate counts were observed for ciprofloxacin (37), cefotaxime (26), ceftriaxone (20), and cefepime (19). Among K. pneumoniae, resistance was recorded for amoxicillin–clavulanic acid (17), cefotaxime (14), and ceftriaxone (12). In the Pseudomonas column, ceftazidime showed 29 recorded resistant isolates, followed by imipenem with 13 and aztreonam with 10. The table also documents resistance among MRSA, MSSA, and Enterococcus isolates. These observations describe the recorded resistance counts; direct comparisons of resistance proportions require confirmation of the corresponding isolate denominators.

DISCUSSION

The present study evaluated the antibiotic consumption, distribution of bacterial pathogens and antimicrobial resistance patterns among intensive care unit (ICU) patients in a tertiary care hospital. The findings demonstrated a predominance of Gram-negative bacterial isolates, particularly Escherichia coli, Pseudomonas spp., and Klebsiella spp., together with resistance to several commonly prescribed antimicrobial agents. These observations highlight the importance of microbiological surveillance and antimicrobial stewardship in critical care settings. Previous studies have identified ICU patients as particularly vulnerable to infections caused by resistant organisms because of invasive procedures, prolonged hospitalisation, exposure to broad-spectrum antibiotics, and underlying clinical conditions.[11]

The present study demonstrated a predominance of Gram-negative bacterial isolates among culture-positive ICU specimens. Escherichia coli was the most frequent organism (27.2%), followed by Pseudomonas spp. (15.6%), Klebsiella pneumoniae

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(15.2%), and K. oxytoca (12.8%). Urine accounted for 39.2% of specimens, followed by pus (24.0%) and blood (17.6%). Recorded resistance involved cephalosporins, fluoroquinolones and carbapenems. Monthly antibiotic-consumption charts showed a penicillin-class October peak for amoxicillin–clavulanic acid, relatively high ceftriaxone consumption during much of the year, consistently higher amikacin than gentamicin consumption, and increasing meropenem consumption in the final quarter. These findings support regular microbiological surveillance, antibiotic-use audits and stewardship review.

Escherichia coli was the most frequently isolated organism (27.2%), followed by Pseudomonas spp. (15.6%), Klebsiella pneumoniae (15.2%), and Klebsiella oxytoca (12.8%). These four bacterial groups collectively represented 70.8% of isolates. Similar concerns regarding Gram-negative bacterial infections have been reported in international ICU surveillance studies. Vincent et al. observed that Gram-negative organisms constituted a substantial proportion of infections among critically ill patients and that infection was associated with adverse clinical outcomes.[12,13] The predominance of these pathogens is clinically important because treatment options may become limited when resistance develops against commonly used antibiotics.

Methicillin-resistant Staphylococcus aureus (MRSA) accounted for 9.6% of all isolates, while methicillin-sensitive S. aureus (MSSA) represented 10.8%. Among the 51 S. aureus isolates, 24 were classified as MRSA. This finding indicates that methicillin resistance was frequently identified within the S. aureus group. Turner et al. described the clinical significance of MRSA infections, including their association with healthcare exposure, invasive infections, and therapeutic challenges.[14] Continued surveillance of MRSA remains essential for guiding empirical treatment and strengthening infection prevention measures.

The antimicrobial resistance findings demonstrated recorded resistance to fluoroquinolones, cephalosporins, and carbapenems among several Gram-negative organisms. In E. coli, ciprofloxacin resistance was recorded in 37 observations, while cefotaxime and ceftriaxone resistance were documented in 26 and 20 observations, respectively. These findings are consistent with the broader concern regarding resistance among Enterobacterales. In a systematic review and meta-analysis, Fasugba et al. demonstrated substantial fluoroquinolone resistance among urinary E. coli isolates, although resistance estimates varied considerably across populations and healthcare settings.[15] Such variation reinforces the importance of institution-specific susceptibility information.

Resistance to third-generation cephalosporins was also documented among Klebsiella isolates. This observation is clinically relevant because resistance to extended-spectrum cephalosporins may complicate the management of severe infections. Castanheira et al. described the global dissemination of extended-spectrum β-lactamase-producing Enterobacterales and the associated challenges for antimicrobial treatment.[16] Nevertheless, the present data do not establish the prevalence of extended-spectrum β-lactamase production because confirmatory phenotypic or molecular testing results were unavailable.

Among Pseudomonas isolates, ceftazidime resistance was recorded in 29 observations, while imipenem resistance was documented in 13. Carbapenem resistance was also recorded among E. coli and Klebsiella isolates. These findings warrant attention because carbapenems are important therapeutic agents for severe Gram-negative infections. Nordmann and Poirel highlighted the clinical importance of carbapenem-resistant Gram-negative bacteria and the need for rapid identification and appropriate treatment strategies.[17]

The analysis of antibiotic consumption demonstrated the predominance of Watch category antibiotics, which accounted for 77.0% of total antibiotic consumption, is consistent with reports from several low-and middle income countries where third – generation cephalosporins and broad spectrum β – lactam agents remain the cornerstone of empirical therapy.[18] Access antibiotic category accounted for only 20.9% of total antibiotic consumption in the present study, however WHO recommends that Access antibiotics should constitute at least of 60% of total antibiotic use. This substantial deviation from WHO targets suggests oppurtunities for improving antimicrobial stewardship and promoting more rationale prescribing practices.[6]

The monthly antibiotic consumption findings demonstrated considerable variation across antimicrobial classes. Third generation cephalosporins emerged as the most frequently utilized antibiotic class contributing 396.4 DDD/100 bed-days. Ceftriaxone, which alone contributed 299.866 DDD/100 bed-days, showed relatively high consumption during several months. In our present study, resistance to ceftriaxone was recorded in E.coli and Klebsiella species and pneumonia isolates. Excessive utilisation of third generation cephalosporins is associated with increasing rates of extended-spectrum β-lactamase (ESBL) producing organisms and should be carefully monitored. Amikacin which is an aminoglycoside, with 87.6 DDD/100 bed-days emerged as the second most commonly utilized antibiotic belonging to access category. This result provide valuable therapeutic options because of its efficacy against gram-negative pathogens and comparatively lower propensity for inducing resistance compared with broad-spectrum cephalosporins. Penicillin plus β lactamase inhibitor combinations is the second most frequently utilized antibiotic class with 117.8 DDD/100 bed days in this study. Piperacillin–tazobactam with 75.047 DDD/100 bed-days was the third most frequently prescribed antibiotics in this study reflecting its established role in empirical treatment of severe

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nosocomial infections. The limited use of Linezolid, which represented the primary Reserve antibiotic with 15.38 DDD/100 bed days consumed during the study period, suggests a degree of adherence to antimicrobial stewardship principles. These trends may help identify periods and drug groups for targeted prescription review; they cannot, by themselves, demonstrate inappropriate use, changes in infection severity, or causal effects on resistance. Klein et al. documented global increases in antibiotic consumption,[18] highlighted geographic variation and the need for standardised monitoring.[19] Similarly, Browne et al. identified marked geographical differences in antibiotic use, emphasising the need for standardised surveillance.[20]

The findings support continued microbiological monitoring, regular review of empirical antibiotic policies, and optimisation of antimicrobial prescribing. Baur et al. demonstrated that antibiotic stewardship interventions can reduce antibiotic resistance and healthcare-associated infections in hospital settings.[21] The present study was limited by the absence of complete antibiotic-specific testing denominators, patient-level clinical outcomes, and verified consumption data. Consequently, resistance proportions, formal multidrug-resistance prevalence, and consumption–resistance associations could not be reliably determined. Despite these limitations, the observed pathogen distribution and recorded resistance patterns provide useful descriptive information for strengthening local antimicrobial surveillance and guiding future stewardship activities.

CONCLUSION

The present study demonstrated a predominance of Gram-negative bacterial isolates among culture-positive specimens obtained from intensive care unit patients. Escherichia coli was the most frequently isolated pathogen (27.2%), followed by Pseudomonas spp. (15.6%), Klebsiella pneumoniae (15.2%), and Klebsiella oxytoca (12.8%). Urine constituted the largest proportion of culture-positive specimens (39.2%), followed by pus (24.0%) and blood (17.6%). Antimicrobial resistance was recorded against several commonly used antibiotics, including cephalosporins, fluoroquinolones, and carbapenems, highlighting the therapeutic challenges associated with bacterial infections in critically ill patients. Monthly antibiotic consumption showed considerable variation, with ceftriaxone demonstrating relatively high utilisation during several months and meropenem consumption increasing toward the end of the observation period. However, the available aggregate data did not permit reliable assessment of the relationship between antibiotic consumption and bacterial resistance. These findings emphasise the importance of continuous microbiological surveillance, periodic review of institutional antibiograms, judicious antibiotic prescribing, and effective antimicrobial stewardship programmes to optimise treatment and limit the emergence of antimicrobial resistance in intensive care settings.

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