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Original Research Article

Drug Utilisation Study of Antimicrobials Prescribed in Intensive Care Unit of a Tertiary Care Hospital

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Abstract

Background: Intensive-care units (ICUs) are major consumers of broad-spectrum antimicrobials, accelerating antimicrobial-resistance (AMR).

Objectives: (i) Characterise the prescription pattern of antimicrobial agents (AMAs) in an adult medical ICU, and (ii) appraise prescribing quality with World Health Organization (WHO) core indicators and defined-daily-dose (DDD) metrics.

Methods: Between 1 January 2023 and 30 June 2024, 270 consecutive adults (≥ 18 y) hospitalised ≥ 24 h in the ICU of the National Institute of Medical Sciences & Research (NIMS), Jaipur, were prospectively enrolled. Demographic, clinical and full medication data were extracted. WHO indicators (drugs / encounter, generic prescribing, encounters with an AMA, an injection and Essential-List drugs) were calculated. AMA consumption was expressed as DDD/100 bed-days (ATC/DDD 2024).

Results: Median age was 54 y (IQR 41–69); 54.4 % were female and 45.6 % were male. Median ICU stay was eight days. In total, 2903 drug orders (median 11 per encounter, IQR 6–14) were written; 93.4 % used generic names. AMAs featured in 79.3 % of encounters (median 3 courses) and injections in 68.9 %. Piperacillin–tazobactam (25.8 %), cefuroxime (23.0 %) and amikacin (12.6 %) were most common. Overall AMA load was 162 DDD/100 bed-days; piperacillin–tazobactam alone contributed 42 DDD/100 bed-days. Only 39 % of AMA items were listed in the 2022 WHO Essential Medicines List. Fixed-dose combinations (FDCs)—chiefly cefuroxime/axetil and amikacin/sulbactam—represented 26 % of AMA prescriptions.

Conclusions: Pronounced polypharmacy, intense empiric broad-spectrum use and poor Essential-List adherence were observed. Embedding a robust antimicrobial-stewardship bundle—culture-guided de-escalation, restriction of high-end agents, pharmacist-led reviews and rapid diagnostics—could rationalise therapy and curb local AMR.

Keywords: Antimicrobial Stewardship; Drug-Utilisation Review; WHO Prescribing Indicators; Defined Daily Dose; Intensive-Care Unit; India.

Introduction

Antimicrobial resistance (AMR) threatens the foundations of critical-care medicine. Invasive devices, haemodynamic instability and device-related infections mandate empiric broad-spectrum antimicrobial agents (AMAs), fostering multidrug-resistant (MDR) pathogens, notably Klebsiella pneumoniae and Acinetobacter baumannii, in Indian ICUs [1–4]. To monitor and improve prescribing, the World Health Organization (WHO) recommends two complementary tools: (i) five core prescribing indicators, giving a rapid snapshot of prescription quality, and (ii) the defined-daily-dose (DDD) methodology, which standardises drug consumption per 100 bed-days and enables benchmarking [5,6]. Indian utilisation studies reveal marked regional heterogeneity and are concentrated in central and southern states [7–10]; northern Rajasthan data are scarce. Moreover, few single-centre studies combine WHO indicators with DDD metrics, evaluate fixed-dose combinations (FDCs) and assess compliance with the WHO Essential Medicines List (EML-2022) in one ICU cohort. We therefore conducted a prospective

drug-utilisation study in the adult medical ICU of a tertiary-care teaching hospital in Jaipur. Primary aim: delineate the spectrum, frequency and volume of AMA prescriptions. Secondary aims: assess WHO-indicator performance, quantify AMA exposure (DDD/100 bed-days) and identify stewardship opportunities, concentrating on FDC use and EML-2022 alignment.

Methods

Design and setting: Prospective, cross-sectional, observational study in the 20-bed open adult medical ICU of NIMS Hospital, Jaipur (Rajasthan, India). The ICU admits ≈ 900 patients annually. The Institutional Ethics Committee approved the protocol (IEC-NIMS/2022/347).

Selection criteria

Inclusion:

- Adult's ≥ 18 years of either sex;
- Admitted between 1 January 2023 and 30 June 2024;
- Expected to receive at least one systemic AMA; and
- Patient or legally authorised representative provided written informed consent.

Exclusion:

- ICU stay < 24 h;
- Incomplete demographic or medication records; or
- Treatment charts with no AMA prescriptions.

Data collection: A structured pro-forma captured demographics, diagnoses, comorbidities, length of stay, outcomes and every drug order (generic/brand, dose, route, frequency, duration).

Double data entry and random chart audits ensured accuracy.

Outcome measures: WHO prescribing indicators: drugs / encounter, generic-name use, encounters with ≥ 1 AMA, encounters with an injection, and percentage of drugs from EML-2022.

AMA consumption: converted to DDD (ATC/DDD 2024) and expressed as DDD/100 bed-days:

$$\frac{\text{Total amount administered (mg)}}{\text{WHO DDD (mg)}} \times \frac{100}{\text{Bed-days}}$$

Bed-days = occupied ICU beds × study days.

Statistical analysis

SPSS v24.0 (IBM, Chicago) was used. Continuous variables are median (IQR) or mean ± SD; categorical variables are frequency (%).

Results

Table 1: Baseline characteristics

Variable	Value
Patients, n	270
Age (mean ± SD)	54.27 ± 20.30
Male/Female, n (%)	123 (45.6%): 147 (54.4%)
ICU stay, days, median (IQR)	8 (6–9)
Top primary diagnoses, n (%)	Acute febrile illness 29 (10.7) Sepsis + AKI 5 (1.85); Chronic kidney disease 24 (8.9)

Table 2: Prescription pattern

WHO indicator	Observed value	WHO ideal
Drugs / encounter, median (IQR)	11 (6–14)	1.6–1.8
Encounters with ≥ 1 AMA	79.3 %	< 30 %*
Encounters with an injection	68.9 %	13–24 %
Generic-name prescribing	93.4 %	100 %
Drugs from EML-2022	39.3 %	100 %

Antimicrobial utilisation: Total AMA consumption was 162 DDD/100 bed-days. Class distribution: β-lactam/β-lactamase-inhibitor combinations 64, third-generation cephalosporins 34, aminoglycosides 21, carbapenems 14, polymyxins 6 DDD/100 bed-days.

Table 3: Fixed-dose combinations

FDC	Prescriptions, n (%)
Cefuroxime + axetil	33 (46.5)
Amikacin + sulbactam	18 (25.4)
Ceftriaxone + sulbactam	12 (16.9)
Amoxicillin + clavulanate	8 (11.2)
Total FDCs	**71**

Discussion

Prescription audit exposed extensive empiric broad-spectrum therapy and polypharmacy, echoing reports from ICUs in Madhya Pradesh, Telangana and Maharashtra [7–10].

AMA exposure (162 DDD/100 bed-days) exceeded that of similar Indian units (110–140 DDD/100 bed-days) [8], driven largely by piperacillin–tazobactam. Only 39 % of AMA items matched the WHO Essential Medicines List, and one-quarter of prescriptions contained FDCs with limited evidence, potentially fuelling AMR. Although 93 % generic prescribing supports affordability, high drug counts (median 11) heighten interaction and toxicity risk, particularly in older patients [15].

A multidisciplinary stewardship bundle—mandatory culture sampling, 48-hour stop-and-review, formulary restriction of high-end agents and non-essential FDCs, pharmacist-led medication audits and rapid diagnostics—has reduced broad-spectrum days by 25–40 % elsewhere [11-14] and is urgently needed here.

Limitations include single-centre design and absence of microbiological outcome data, but combining WHO indicators with DDD analytics provides a transferable framework for other ICUs.

Conclusion

AMA use in this Jaipur ICU is intensive, empiric and poorly aligned with WHO essential-medicine guidance, elevating resistance, toxicity and cost. Embedding a rigorous stewardship programme—culture-driven de-escalation, restriction of high-end and fixed-dose agents, pharmacist-led medication reviews, rapid diagnostics and monthly audit-feedback dashboards—can rationalise therapy, trim DDD totals and blunt the rise of MDR pathogens.

Sustained administrative support and periodic policy review anchored to local antibiograms will be critical for lasting impact.

Ethical approval & consent: Approved by IEC-NIMS/2022/347. Written informed consent obtained from patients or legal surrogates.

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