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Original Article

Drug Utilization Pattern in ICU Patients in a Tertiary Care Hospital

Corresponding Author:
Dr. Shikha Kumari

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Dr. Amit Kumar[1], Dr. Shikha Kumari[2]

[1]Associate Professor, Department of General Medicine, Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar, India

[2]Assistant Professor, Department of Pharmacology, Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar, India.

ABSTRACT

Background: Critically ill patients in the intensive care unit (ICU) are exposed to a large number of drugs because of multi-organ involvement, the need for prophylaxis and the aggressive management of sepsis and nosocomial infection. This predisposes them to polypharmacy, drug–drug interactions, adverse drug reactions and rising treatment cost. Periodic drug utilization studies act as a medical audit to monitor and rationalise prescribing.

Objectives: To evaluate the pattern of drug utilization among ICU patients of a tertiary care hospital, including the commonly prescribed drugs, the average number of drugs per patient, the pattern of antibiotic and supportive drug use, the extent of polypharmacy, generic versus brand and route of administration, and the use of essential medicines.

Methods: An observational study was carried out on 50 patients admitted to the ICU. Data were collected on a structured proforma and analysed for demographic profile, diagnosis, drug-class utilization, WHO core prescribing indicators, polypharmacy, route of administration, fixed-dose combinations, adverse drug reactions, potential drug–drug interaction risk and outcome. Data were summarised using descriptive statistics; the t-test, chi-square test and Pearson correlation were applied where appropriate, with $p < 0.05$ considered significant.

Results: Of 50 patients, 31 (62%) were male and the mean age was 55.1 ± 17.7 years, with 48% aged over 60 years. Sepsis/septic shock (28%) and pneumonia/ARDS (22%) were the commonest indications. The mean ICU stay was 9.5 ± 3.7 days and 26 (52%) patients required mechanical ventilation. A total of 645 drugs were prescribed, averaging 12.9 ± 3.7 drugs per patient; major polypharmacy (≥10 drugs) was seen in 76% of patients. Intravenous fluids and proton-pump inhibitors were prescribed to all patients (100%), antibiotics to 90% and analgesics to 76%. The intravenous route was used in every patient. Antibiotics were mostly empirical (76% of all patients), with only 14% culture-guided. Generic drugs accounted for 56.0% of prescriptions and 64.0% of drugs were from the essential medicines list. Adverse drug reactions were noted in 20% of patients and 90% had a moderate-to-high drug–drug interaction risk. The mortality rate was 18%.

Conclusion: ICU prescribing was characterised by marked polypharmacy, universal injectable use and a high, largely empirical, antibiotic load. Promoting generic prescribing, adherence to the essential medicines list and culture-guided antimicrobial stewardship are the key areas for rationalising ICU drug therapy.

Keywords: Drug utilization; intensive care unit; polypharmacy; WHO prescribing indicators; antimicrobial stewardship; essential medicines; rational drug use.

INTRODUCTION

The World Health Organization (WHO) defines drug utilization research as the study of the marketing, distribution, prescription and use of drugs in a society, with particular emphasis on the resulting medical, social and economic consequences. Its ultimate aim is to promote the rational use of medicines, whereby patients receive drugs appropriate to their clinical needs, in adequate doses, for an adequate duration, and at the lowest cost to them and the community.

The intensive care unit (ICU) is among the most therapeutically demanding settings in any hospital. Critically ill patients frequently have multi-organ dysfunction, haemodynamic instability and altered pharmacokinetics, and routinely require a wide spectrum of medications — intravenous fluids, vasopressors, sedatives and analgesics, stress-ulcer and thromboprophylaxis and, very commonly, broad-spectrum antimicrobials. Consequently, ICU patients receive more drugs than patients in any other ward, increasing the likelihood of polypharmacy, drug–drug interactions, adverse drug reactions and therapeutic failure, while also contributing substantially to the cost of care.

Empirical and often prolonged antimicrobial use is a particular feature of ICU prescribing. Although necessary to control life-threatening infection, inappropriate antimicrobial use is a major driver of antimicrobial resistance, now recognised as a critical global public-health threat. Monitoring how drugs — and antimicrobials in particular — are used in the ICU therefore serves as an important audit, allowing prescribing to be evaluated and made more rational and cost-effective.

WHO core prescribing indicators provide standardised, reproducible tools for such audits and permit comparison across units and institutions. Against this background, the present study was undertaken in the ICU of a tertiary care teaching hospital to evaluate the pattern of drug utilization and to identify priority areas for improvement in prescribing.

Aim and Objectives

Aim: To evaluate the pattern of drug utilization among patients admitted to the Intensive Care Unit of a tertiary care hospital.

Objectives:

- To assess the commonly prescribed drugs among ICU patients.
- To evaluate the average number of drugs prescribed per patient.
- To study the pattern of antibiotic, analgesic, sedative, cardiovascular, gastrointestinal and supportive drug use.
- To assess the extent of polypharmacy among ICU patients.
- To evaluate drug prescriptions according to generic/brand name and route of administration.
- To identify the frequency of use of essential medicines in ICU prescriptions.

MATERIALS AND METHODS

Study design, setting and period

This was an observational study conducted in the Intensive Care Unit of Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar — a tertiary care teaching hospital. A total of 50 patients fulfilling the eligibility criteria were studied over a period of February 2024 to January-2025

Inclusion and exclusion criteria

Patients of either sex admitted to the ICU during the study period for any medical or surgical indication were included. Patients with incomplete or illegible treatment records were excluded.

Data collection

Data were collected from treatment charts using a structured, pre-tested proforma. The variables recorded were: age, sex, weight, primary diagnosis, reason for ICU admission, comorbidities, duration of ICU stay, requirement and duration of mechanical ventilation, total number of drugs prescribed, the major therapeutic classes prescribed, the antibiotic utilization pattern, the predominant route of administration, the number of drugs prescribed by generic and brand name, the number of drugs from the essential medicines list, the number of fixed-dose combinations (FDCs), occurrence of adverse drug reactions (ADRs), the potential drug–drug interaction (DDI) risk and the ICU outcome.

Study parameters

Drug utilization was evaluated using WHO core prescribing indicators — the average number of drugs per patient, the percentage of drugs prescribed by generic name, the percentage of patients receiving an antibiotic, the percentage of patients receiving an injection, and the percentage of drugs from the essential medicines list. Polypharmacy was defined

as the concurrent use of five or more drugs, and major polypharmacy as ten or more drugs. Antibiotic use was further classified as no antibiotic, single empirical, two- or three-drug empirical combination, or culture-guided therapy.

Statistical analysis

Data were entered into Microsoft Excel and analysed using **SPSS ver-26.0**. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. The independent t-test was used to compare the drug burden between mechanically ventilated and non-ventilated patients, the chi-square test to examine associations between categorical variables, and the Pearson correlation coefficient to assess the relationship between ICU stay and the number of drugs prescribed. A p-value < 0.05 was considered statistically significant.

RESULTS

Demographic and clinical profile

A total of 50 ICU patients were studied. Thirty-one (62%) were male and 19 (38%) female, giving a male-to-female ratio of 1.63:1. The mean age was 55.1 ± 17.7 years (range 26–84 years), and nearly half of the patients (48%) were older than 60 years. The mean body weight was 62.2 ± 11.9 kg. The mean duration of ICU stay was 9.5 ± 3.7 days (range 2–16). Mechanical ventilation was required by 26 patients (52%), with a mean ventilation duration of 6.0 ± 3.4 days among those ventilated. Hypertension (46%) and diabetes mellitus (40%) were the commonest comorbidities, and 41 patients (82%) had at least one comorbidity (Table 1).

Table 1. *Demographic and clinical characteristics of the study population (N = 50).*

Characteristic	Number (n)	Percentage (%)
Male	31	62.0
Female	19	38.0
Age 21–40 years	12	24.0
Age 41–60 years	14	28.0
Age > 60 years	24	48.0
Mechanical ventilation required	26	52.0
≥ 1 comorbidity	41	82.0
Mean age (years)	55.1 ± 17.7	—
Mean ICU stay (days)	9.5 ± 3.7	—

Distribution of primary diagnosis

The most common reason for ICU admission was sepsis/septic shock (28%), followed by pneumonia/ARDS (22%), post-operative monitoring (14%) and acute pancreatitis (12%). The distribution of admitting diagnoses is shown in Table 2.

Table 2. *Distribution of patients according to primary diagnosis.*

Primary diagnosis	Number (n)	Percentage (%)
Sepsis / septic shock	14	28.0
Pneumonia / ARDS	11	22.0
Post-operative monitoring	7	14.0
Acute pancreatitis	6	12.0
Cerebrovascular accident	4	8.0
Acute myocardial infarction	3	6.0
Diabetic ketoacidosis	2	4.0
COPD exacerbation	1	2.0
Road traffic trauma	1	2.0
CKD with pulmonary edema	1	2.0
Total	**50**	**100.0**

Average number of drugs and polypharmacy

A total of 645 drugs were prescribed to 50 patients, giving an average of 12.9 ± 3.7 drugs per patient (median 13, range 6–19). Every patient received five or more drugs; major polypharmacy (≥10 drugs) was observed in 38 patients (76%), and 17 patients (34%) received 15 or more drugs. The drug burden was significantly higher in mechanically ventilated patients (15.0 ± 2.6 drugs) than in non-ventilated patients (10.6 ± 3.4 drugs; $t = 5.14$, $p < 0.001$), and the number of drugs prescribed correlated positively with the duration of ICU stay (Pearson $r = 0.55$, $p < 0.001$).

Table 3. *Extent of polypharmacy among ICU patients (N = 50).*

Drug burden category	Number (n)	Percentage (%)
≥ 5 drugs (polypharmacy)	50	100.0
≥ 10 drugs (major polypharmacy)	38	76.0
≥ 15 drugs	17	34.0
Mean ± SD drugs per patient	12.9 ± 3.7	—

Pattern of drug-class utilization

Intravenous fluids and proton-pump inhibitors (for stress-ulcer prophylaxis) were prescribed to all 50 patients (100%). Antibiotics were the most frequently prescribed pharmacologically active class (90%), followed by analgesics (76%), sedatives (52%) and vasopressors (40%). Cardiovascular agents (anticoagulant/antiplatelet, statin, antihypertensive) and respiratory agents (bronchodilators, steroids, nebulisation) reflected the underlying diagnoses. The frequency of the major therapeutic classes is shown in Table 4.

Table 4. *Frequency of major therapeutic drug classes prescribed (percentage of patients receiving each class).*

Drug class	Patients (n)	Percentage (%)
IV fluids (supportive)	50	100.0
Proton-pump inhibitor (GI)	50	100.0
Antibiotic	45	90.0
Analgesic	38	76.0
Sedative	26	52.0
Vasopressor (cardiovascular)	20	40.0
Bronchodilator	12	24.0
Steroid	12	24.0
Antiemetic	7	14.0
Anticoagulant / antiplatelet	7	14.0
Statin	7	14.0
Nebulisation	6	12.0
Insulin	5	10.0
Antihypertensive	5	10.0
Antiepileptic	4	8.0
Vitamin / mineral	4	8.0
Laxative	4	8.0
Electrolyte correction	2	4.0
Diuretic	1	2.0

Pattern of antibiotic utilization

Forty-five patients (90%) received at least one antibiotic. Empirical therapy predominated: a two-drug empirical combination was the commonest pattern (44%), followed by single empirical antibiotic therapy (28%) and three-drug empirical combination (4%). Culture-guided therapy accounted for only 14% of patients, while 10% received no antibiotic (Table 5).

Table 5. *Pattern of antibiotic utilization.*

Antibiotic utilization pattern	Number (n)	Percentage (%)
Two-drug empirical combination	22	44.0
Single empirical antibiotic	14	28.0
Culture-guided antibiotic	7	14.0
No antibiotic	5	10.0
Three-drug empirical combination	2	4.0
Total	**50**	**100.0**

Generic versus brand prescribing and route of administration

Of the 645 drugs prescribed, 361 (56.0%) were prescribed by generic name and 284 (44.0%) by brand name; the mean proportion of generic prescribing per patient was 55.8 ± 13.2%. Fixed-dose combinations were used in 38 patients (76%), totalling 76 FDCs. The intravenous route was involved in the prescriptions of every patient (100%); the intravenous-only route was predominant in 44%, followed by intravenous plus oral (26%), intravenous plus subcutaneous (14%) and intravenous plus nebulisation (14%). The percentage of patients receiving an injection — a WHO core indicator — was therefore 100% (Table 6).

Table 6. *Predominant route of administration.*

Predominant route	Number (n)	Percentage (%)
Intravenous only	22	44.0
IV + Oral	13	26.0
IV + Subcutaneous	7	14.0
IV + Nebulisation	7	14.0
Oral + IV + Nebulisation	1	2.0

Use of essential medicines and WHO core prescribing indicators

A total of 413 drugs (64.0% of all prescriptions) were from the essential medicines list, with a mean per-patient essential-medicine proportion of 64.7 ± 15.5%. The WHO core prescribing indicators for the cohort are summarised in Table 7.

Table 7. *WHO core prescribing indicators.*

Prescribing indicator	Value
Average number of drugs per patient	12.9 ± 3.7
Drugs prescribed by generic name (%)	56.0
Patients receiving an antibiotic (%)	90.0
Patients receiving an injection (%)	100.0
Drugs from the essential medicines list (%)	64.0

Adverse drug reactions, interaction risk and outcome

Adverse drug reactions were documented in 10 patients (20%) — minor in 8 (16%) and moderate in 2 (4%); none were severe. The potential drug–drug interaction risk was moderate in 29 patients (58%) and high in 16 (32%), so that 90% of patients carried a moderate-to-high interaction risk, consistent with the high drug burden. Regarding outcome, 35 patients (70%) improved and were shifted to the ward, 5 (10%) were referred, 1 (2%) was discharged against medical advice and 9 (18%) died. There was no statistically significant association between mechanical ventilation and mortality in this sample ($p = 1.00$) (Table 8).

Table 8. *Adverse drug reactions, drug–drug interaction risk and ICU outcome.*

Parameter	Category	n (%)
ADR observed	Any ADR	10 (20.0)
	Minor	8 (16.0)
	Moderate	2 (4.0)
DDI risk	High	16 (32.0)

Parameter	Category	n (%)
	Moderate	29 (58.0)
	Low	5 (10.0)
Outcome	Improved / shifted to ward	35 (70.0)
	Referred	5 (10.0)
	Death	9 (18.0)
	DAMA	1 (2.0)

DISCUSSION

This study evaluated the pattern of drug utilization in the ICU of a tertiary care teaching hospital in 50 critically ill patients. As is characteristic of intensive care, prescribing was dominated by polypharmacy, universal injectable use and a high, largely empirical, antibiotic load — findings broadly consistent with previously published Indian ICU studies.

The mean of 12.9 drugs per patient confirms the substantial therapeutic burden of ICU care, with major polypharmacy (≥10 drugs) in three-quarters of patients. Comparable Indian studies have reported averages ranging from about nine to as many as fifteen or sixteen drugs per patient, underscoring that polypharmacy is the norm rather than the exception in this setting, driven by disease severity, multi-organ involvement and routine prophylaxis. The drug burden rose significantly with the need for mechanical ventilation and correlated with the length of ICU stay, reflecting the greater complexity of care in sicker patients. Although a degree of polypharmacy is unavoidable in intensive care, the associated moderate-to-high drug–drug interaction risk in 90% of patients reinforces the need for regular medication review and timely de-prescribing once a drug is no longer indicated.

Intravenous fluids and proton-pump inhibitors were prescribed to every patient, the latter reflecting near-universal stress-ulcer prophylaxis. While appropriate for high-risk patients, such prophylaxis is frequently continued unnecessarily and is a recognised target for de-prescribing. Analgesics, sedatives and vasopressors featured prominently, in keeping with the haemodynamic and ventilatory support required by this population.

Antibiotic exposure was high, with 90% of patients receiving at least one antibiotic — a figure that mirrors the recognised reality that critically ill patients often require empirical broad-spectrum therapy before culture results are available. However, empirical regimens accounted for the great majority of antibiotic use, while only 14% of patients received culture-guided therapy. This imbalance highlights the need for stronger antimicrobial stewardship, including early sampling, timely de-escalation based on culture and sensitivity reports, and adherence to local antibiotic policy, to limit the emergence of antimicrobial resistance that is of pressing concern in Indian ICUs.

Generic prescribing accounted for 56% of drugs and only 64% of drugs were from the essential medicines list — both markers of rational, cost-effective prescribing that fall short of the ideal of near-universal generic and essential-medicine use. These represent readily modifiable targets through prescriber education, institutional formulary policy and the use of the National List of Essential Medicines. The injection rate of 100% is expected in an ICU population but, together with the high FDC use, reinforces the importance of monitoring prescribing quality even where parenteral therapy is clinically justified.

Adverse drug reactions were recorded in 20% of patients, all minor or moderate, and the overall ICU mortality of 18% is within the range reported for mixed medical–surgical ICUs. No significant association between mechanical ventilation and mortality emerged in this relatively small sample, which the study was not powered to detect.

Limitations

- The study was conducted at a single centre on a modest sample of 50 patients, which limits generalisability and the power to detect associations with outcome.
- Being an observational drug utilization study, it describes prescribing patterns rather than directly assessing the clinical appropriateness of individual prescriptions.
- Defined daily dose (DDD/100 bed-days) was not calculated, as drug-level dosing data were not part of the dataset; future work could incorporate ATC/DDD quantification and cost analysis.

CONCLUSION

Drug therapy in this ICU was characterised by marked polypharmacy (mean 12.9 drugs per patient), universal injectable and stress-ulcer-prophylaxis use, and a high but largely empirical antibiotic load. Generic prescribing (56%) and essential-medicine use (64%) were sub-optimal. The findings identify clear opportunities to rationalise ICU prescribing — chiefly

limiting unnecessary polypharmacy, strengthening generic and essential-medicine prescribing, and reinforcing culture-guided antimicrobial stewardship. Periodic drug utilization audits using WHO prescribing indicators should be incorporated into routine ICU practice to monitor and improve the quality, safety and cost-effectiveness of prescribing.

Declarations
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