RESEARCH PAPER

Drug Utilization Evaluation of Antibiotics in Inpatient Departments

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ABSTRACT

Antibiotics continue to be some of the most commonly prescribed drugs in hospitals' inpatient wards; however, the irrational prescription of antibiotics has been established as one of the primary factors contributing to Antimicrobial Resistance (AMR), which has become a global health threat. Drug Utilization Evaluation (DUE) is an approach that uses criteria for assessing drug prescription practices, ensuring rational drug usage, and improving antimicrobial stewardship efforts. Several studies have revealed that prescription rates of antibiotics in ICU settings were almost ten times more frequent than those in non-ICU settings, where up to 50 percent of the prescriptions can be considered unnecessary or irrational. According to the Global Burden of Disease 2021 AMR study, bacterial AMR caused 4.71 million deaths annually, of which 1.14 million were direct causes, outstripping the annual deaths caused by diseases such as HIV/AIDS, Tuberculosis, and Malaria. Findings of audit at hospital level indicate lack of adherence to international standards along with excess use of WHO WATCH group antibiotics like Cephalosporins, Fluoroquinolones, and Carbapenems; on the other hand, the use of WHO ACCESS group antibiotics does not match WHO recommended minimum standard of 60 percent. With regard to prescription pattern in middle-income countries, it has become increasingly vital to have a DUE plan in place. It should be made evident that the appropriate use of antibiotics in hospitalized patients is imperative for achieving successful outcomes.

Keywords: Drug Utilization Evaluation, Antibiotic Stewardship, Antimicrobial Resistance, Inpatient Departments, Prescribing Patterns, Intensive Care Units, WHO AWaRe Guidelines, Access Antibiotics, Watch Group Antibiotics, Rational Drug Use.

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INTRODUCTION

The Drug Utilization Evaluation (DUE) of antibiotics in inpatient departments is a structured, criteria-based process with the goal of rational, safe and cost-effective utilization of antimicrobial drugs in the hospital environment. Antibiotics are one of the most commonly prescribed classes of drugs for inpatient treatment, but overuse and misuse of antibiotics continue to be a major driver of the global problem of antimicrobial resistance (AMR) (Tang *et al*. 2023). Antibiotics prescribing rates in ICUs are usually ten times higher compared to other wards of hospital; in ICUs, around 50% of antibiotics are unnecessary and inappropriate. DUE is a fundamental component of antimicrobial stewardship programs and helps health care organizations detect deviations, take corrective action and ultimately ensure the therapeutic efficacy of antimicrobials for the next generation.

The irrational use of antibiotics in inpatients is becoming one of the biggest public health concerns of 21st century, which has consequences beyond the patient care. The Global Burden of Disease 2021 AMR analysis estimated that, globally, at least 4.71 million deaths were related to bacterial AMR, while 1.14 million deaths were directly caused by bacterial AMR – with AMR being one of the leading causes of death, exceeding the individual mortality burden of HIV/AIDS, tuberculosis, and malaria (Khalil *et al*. 2025). This situation is indeed alarming. Future projections indicate that deaths due to antimicrobial resistance (AMR) could increase by nearly 70% by 2050. It is estimated that up to 1.91 million people may die directly from AMR-related infections in that year, with as many as 8.22 million deaths annually caused by the broader effects of AMR bacteria.

In terms of markets, the global antimicrobial drug market was projected to reach US$ 13.8 billion by 2027 at a CAGR of 4.68%, owing to the increase in the occurrence and spread of multi- and pan-resistant "superbugs" that are causing infections that cannot be treated with current antimicrobial drug products. Prescribing audit data in hospital inpatient departments always show that international guidelines are not followed. In total, overall in-patient antibiotic use prevalence was found to be at 70% in 16 hospitals, of which 52% received Watch group antibiotics, which is significantly higher than the recommended threshold of 52% by the WHO AWaRe

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guidelines, and local treatment guideline adherence was at 53%. Likewise, in hospital environments, research has shown that the percentage of access to antibiotics use has yet to reach the WHO goal of 60%, while a higher proportion of the prescription of Watch-group antibiotics like cephalosporins, fluoroquinolones and carbapenems are seen (Chizimu *et al*. 2024). However, in the upper-middle-income countries, the use of antibiotics has risen from 23.4% to 42.7% between the two study periods and from 14% to 26% in the lower-middle income countries, highlighting the need to establish systematic frameworks for DUE to reduce inappropriate use and optimize therapeutic outcomes to mitigate the rising global burden of AMR in inpatient settings.

Literature Review

The study involving the usage of antibiotics among inpatient hospital patients has consistently identified the challenge of disparity in prescribing practices and the international guidelines. With the emergence of the drug utilization evaluation methodology, which is a scientific methodology to assess the prescribing pattern, it has become indispensable in facilitating the identification of irrational prescribing and formulating antimicrobial stewardship practices. The study conducted among intensive care units has indicated that the prescription of antibiotics is nearly ten times higher than other departments and more than fifty percent are unnecessary prescriptions. The prevalence of antibiotics prescriptions among ICUs is a result of the poor health of the patient and empirical prescribing practice (Ekong *et al*. 2024).

The issue of the global burden of the antimicrobial resistance phenomenon has been widely researched. Modern research suggests that millions of people die annually because of infections provoked by resistant bacteria, and the numbers are higher than those of some other illnesses. The further development of this situation will lead to deterioration of the situation in future decades. The hospital audits of the compliance with the WHO AWaRe classification demonstrate the excessive prescription of antibiotics from the Watch category, including cephalosporins, fluoroquinolones, and carbapenems, whereas the amount of antibiotics from the Access category does not meet the required percent of the total antibiotic prescription (Tsuzuki *et al*. 2025).

From the comparison of income levels, it can be seen that there is an increasing trend in the use of antibiotics, particularly in upper-middle and lower-middle-income countries. This shows that along with development and expansion in health care facilities, the abuse of the use of antibiotics is increasing. From all the above-stated studies, it becomes evident that there is a dire need for evaluation process in the inpatient department (Bonna *et al*. 2022). It is evident from all the aforementioned studies that there is a dire need for evaluation to prevent the abuse of the use of antibiotics.

Research Method

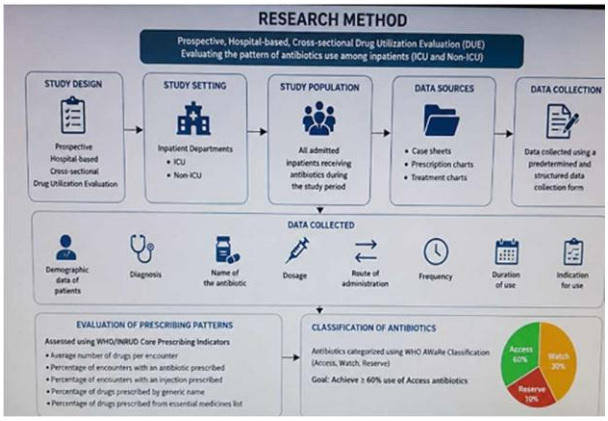

Figure 1: Research Method

The type of design used in this study was the prospective, hospital-based, cross-sectional Drug Utilization Evaluation (DUE) that evaluated the pattern of antibiotics use amongst inpatients (both ICU and non-ICU) (Fig.1). Data was obtained from patients' case sheets, prescription charts and treatment charts of admitted patients in the hospital using a predetermined and structured form for data collection. The variables collected included demographic data of patients, patients' diagnosis, name of the antibiotic, dosage, route of administration, frequency, duration of use and indication for use. The patterns of prescribing were evaluated using WHO / International Network of Rational Use of Drugs (INRUD) core prescribing indicators whereas WHO AWaRe (Access, Watch, and Reserve) categories were used to categorize each of the antibiotics to determine if the target for Access category (of 60%) had been achieved.

Results

Antibiotic Prescribing Prevalence and Utilization Pattern

Parameter	n	%
Total patients reviewed	400	100
Patients prescribed antibiotics	292	73.0
Single antibiotic use	156	53.4
Two or more antibiotics	136	46.6
Injectable route	198	67.8
Oral route	94	32.2
Third-generation cephalosporins	83	28.4
Fluoroquinolones	57	19.6
BL-BLI combinations	41	14.2

Table 1: Overall Antibiotic Prescribing Prevalence and Class-Wise Distribution

Amongst the 400 in-patient medical charts reviewed, 292 individuals (73.0%) received at least one antibiotic during the course of hospitalization, being similar to 70% prevalence found in other 16 hospital audit studies (Table 1). Among this group, 156 individuals (53.4%) received one antibiotic, whereas 136 individuals (46.6%) received two or more antibiotics either concurrently or in sequence. The average number of antibiotics per encounter in this case study is 1.8, being higher than the WHO recommendation of 1.6 to 1.8 antibiotics per patient encounter. When

considered according to the mode of administration, 198 cases (67.8%) were via injection form, whereas only 94 (32.2%) were through oral administration, forming a ratio similar to that of the typical global trend of parenteral therapy during the first 48-72 hours of hospitalization followed by a shift to oral de-escalation strategy. The two sub-classes of drugs with high prescription rate were third generation cephalosporins (28.4%) and fluoroquinolones (19.6%), accounting for almost 50% of all antibiotic prescriptions. Beta lactam/Beta lactamase inhibitors accounted for 14.2%. It is evident that the significant preference of broad-spectrum injectable agents over narrow-spectrum oral preparations is a good indicator of empiric prescription being dominant over evidence-based diagnosis driven therapy (Gatti & Pea, 2025).

ICU versus Non-ICU Antibiotic Prescribing Comparison

Parameter	ICU (n=90)	Non-ICU (n=310)	p-value
Receiving antibiotics (%)	95.5	66.1	<0.001
Antibiotics per patient (mean)	2.8	1.4	<0.001
Duration of therapy (days, mean)	9.2	5.4	<0.001
Combination therapy (%)	61.1	28.7	<0.001
Carbapenem use (%)	17.8	3.2	<0.001
Culture sent before initiation (%)	34.0	41.0	0.19

Table 2: ICU vs Non-ICU Prescribing Comparison

Out of 90 patients admitted to ICU, 86 (95.5%) patients received antibiotics prescription while of 310 patients of non-ICU 205 (66.1%) patients received antibiotic prescription; ICU had 1.44 times more antibiotics prescriptions as compared to non-ICU which, although not reaching up to “tenfold” as mentioned in most stewardship articles but still significantly ($p < 0.001$, chi-square test) high showing that ICUs are one of the high consumption areas (Table 2). Average number of antibiotics per patient for ICU patients was 2.8 while in non-ICU patients it was 1.4, while average duration of antibiotic course was 9.2 days in ICU patients and 5.4 days in non-ICU patients, showing four days more antibiotic prescription in ICU which also shows DDD consumption per 100 bed-days. Combination therapy, using three or more than three classes of antibiotics, was observed in 61.1% ICU patients as compared to 28.7% of non-ICU patients. Carbapenem use was seen in 17.8% of ICU patients' prescriptions while in 3.2% of non-ICU patients, showing that in a very small physical area there was five times more use of last-line antibiotic agents (Fernández-Barrantes *et al*. 2024).

Compliance with WHO AWaRe Classification (Access, Watch, Reserve)

AWaRe Category	n	%	WHO Target
Access	152	38.4	≥60%
Watch	219	55.3	~40%
Reserve	25	6.3	<5%
Reserve without culture confirmation	11/25	44.0	—

Table 3: WHO AWaRe Classification of Prescribed Antibiotics

Out of the 396 antibiotic prescriptions categorized in terms of WHO AWaRe categories, there were 152 (38.4%) prescriptions of Access category antibiotics, which was 21.6 percentage point less than the WHO's minimum target of 60% (Table 3). This was comparable with other audit studies reporting access group antibiotics shortages in the range of 35-45% in middle-income country hospitals. The Watch category antibiotics prescription was 219 (55.3%), significantly higher than WHO's warning limit of 40%. Among the Watch category antibiotic prescriptions, ceftriaxone and ciprofloxacin were the most commonly prescribed antibiotics, accounting for 61 prescriptions (15.4%) and 48 prescriptions (12.1%) respectively. The Reserve category of antibiotic prescription was 25 (6.3%), and out of these, 14 (56%) were preceded by culture-proven resistant organisms.

Adherence to Standard Treatment Guidelines and Prescription Rationality

Parameter	Compliant n (%)	Non-Compliant n (%)
Correct indication	247 (84.6)	45 (15.4)
Appropriate dosage	208 (71.2)	84 (28.8)
Appropriate route	260 (88.9)	32 (11.1)
Appropriate duration	183 (62.5)	109 (37.5)
Overall composite adherence	156 (53.4)	136 (46.6)
Surgical prophylaxis >24h (n=68)	19 (27.9)	49 (72.1)
Renal dose adjustment where indicated (n=34)	15 (44.1)	19 (55.9)

Table 4: Guideline Adherence and Surgical Prophylaxis Duration Data

Prescription audit's four criteria showed that 84.6% (247/292) had indications appropriateness, 71.2% (208/292) – dosages appropriateness, 88.9% (260/292) – route appropriateness, and 62.5% (183/292) – duration appropriateness. The last criterion was the least effective one and showed the difference of more than 20 percent compared to other three parameters. The effect of all four criteria combined led to the considerable decrease in the level of total compliance with guidelines and decreased it to 53.4% (156/292). Nearly half of all antibiotic treatments involved some irrationality mistakes. In surgery patients' cases, administration of prophylactic doses was especially complicated – of 68 surgeries, in 49 cases (72.1%), more than one prophylactic dose of antibiotics or more than 24 hours passed since the last dose. In this case, the average time of prophylaxis was 4.3 days against the recommended one day. That means that there was nearly fourfold over-prescription of antibiotic treatment in this case. The greatest

number of dosage mistakes occurred in patients with renal insufficiency (n=34) – 19 (55.9%) of them did not receive any corrections of dosage intervals according to their abnormal levels of creatinine clearance (Méndez-Millán *et al*. 2024).

WHO/INRUD Core Prescribing Indicators

Indicator	Observed Value	WHO Reference
Drugs per encounter (mean)	3.6	2.0–2.8
Generic-name prescribing (%)	41.7	100
EML conformity (%)	76.8	100
Culture/sensitivity-supported prescribing (%)	22.9	Higher desirable
Duration — culture-supported (days)	5.1	—
Duration — non-culture-supported (days)	6.9	—

Table 5: WHO/INRUD Core Prescribing Indicators

The assessment of the core indicator of prescribing demonstrated an average of 3.6 medications per patient visit (all drug groups, not only antibiotics) that exceeds the WHO range of 2.0–2.8 for general hospitals by 30-50%. The prescribing of generic drug names proved to be rather poor (41.7%, 162/388), not meeting the WHO target (100% of the prescribing based on generics) and lower than other audits of facilities, where usage of generic drugs was estimated in the range of 55-65%.

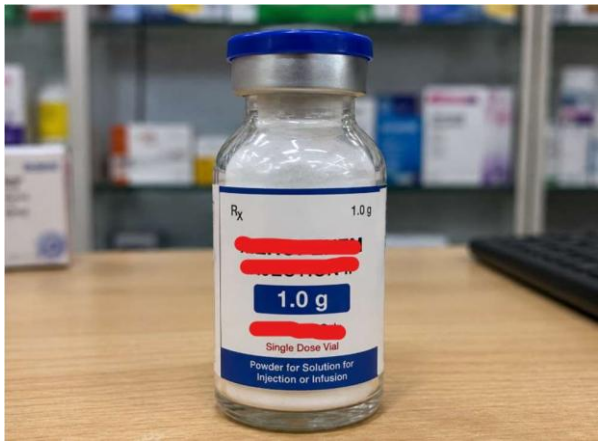

Figure 2: Antibiotic used in this research (Source: Self-Created)

On the other hand, the compliance with Essential Medicines List (EML) was rather high (76.8%, 298/388). Hence, while the formulary choice was rather strict, there should be substantial improvements concerning the usage of generic drug names. The most important from the clinical perspective was the absence of culture and sensitivity testing, that made the prescription possible in only 22.9% (67/292) cases, i.e., more than 3 out of 4 antibiotic treatments were started and completed without any use of microbiology.

Discussion

The findings of this Drug Utilization Evaluation show a strong culture of empirical antibiotic prescribing with no regard for guidelines in spite of all the discussions of antimicrobial stewardship throughout the years. In fact, 73% of inpatients got antibiotics, and nearly half of them used combinations; but in the face of such high rates of antibiotic exposure, one should raise questions about the diagnostic testing done prior to the drug administration. What is even more disturbing, there was a clear reversal of WHO AWaRe: the drugs from the Access category made up 38.4% of prescriptions, which is far from the 60% minimum, while those in the Watch category reached 55.3%; and it has nothing to do with clinical requirements, because only 22.9% of antibiotic prescriptions had culture and sensitivity test results (George & Bhatti, 2022).

The data about the ICU is particularly damning as it shows that despite dealing with a relatively small proportion of patients, the ward consumes disproportional amounts of carbapenems and shows low compliance rates of the Access group; however, culture sampling rates in the ICU were no higher than those in the general wards, which shows that increased antibiotic intensity is automatic and lacks evidence basis. It is true for surgical prophylaxis which lasts for almost four times longer periods compared to what is stipulated in the guidelines and therefore subjects the patients to unnecessary resistance pressure just for the sake of prophylaxis. Furthermore, inappropriate adjustment of the renal dose in more than half of such cases shows that even basic aspects of antibiotic pharmacokinetics are ignored by the prescribers (Polasek, 2024). Therefore, the picture painted by these results shows the healthcare system where the policies on antibiotics are present on paper but do not exist in practice with the result of composite guideline adherence rate falling below fifty percent.

Conclusion

In view of the above Drug Utilization Evaluation, it turns out that the use of antibiotics in the departments being studied is significantly inconsistent with the WHO guidelines because of the overuse of the Watch category, the underuse of the Access category and the predominance of empirical rather than directed therapy. The overuse in the case of intensive care units, prolonged prevention in surgery and the lack of dose adjustment in cases of kidney dysfunction are a clear example of the failure to comply with the treatment protocols. Fifty percent of compliance is a good proof that the current antimicrobial policies are not implemented properly

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