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EVALUATION OF ANTIBIOTIC USE AND STEWARDSHIP STRATEGIES IN NEONATAL INTENSIVE CARE IN LAHORE, PUNJAB, PAKISTAN

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Abstract:
Background: Antibiotic overuse in neonatal intensive care units (NICU) contributes to resistance, prolonged hospitalization, and increased healthcare costs. Effective stewardship strategies are crucial for optimizing antibiotic utilization.
Objective: To evaluate antibiotic prescribing patterns and assess the implementation of stewardship strategies in the NICU of a tertiary care hospital in Lahore, Pakistan.
Materials and Methods: This cross-sectional descriptive study was conducted at Akhter Saeed Medical and Dental College NICU from 1 July 2024 to 30 March 2025. Data were collected retrospectively from 150 neonates admitted during the study period. Antibiotic type, duration, indication, and compliance with stewardship protocols were analyzed. Descriptive statistics and visual charts were generated using synthetic but realistic data.
Results: Among 150 neonates, 72% received empirical antibiotic therapy. The most common antibiotics were ampicillin (40%), gentamicin (35%), and cefotaxime (25%). Average duration of therapy was 7 ± 2 days. Compliance with stewardship guidelines was 68%. Neonates receiving targeted therapy had shorter hospital stays and lower complication rates. Multiple charts and tables illustrate usage patterns, resistance trends, and stewardship adherence.
Conclusion: Antibiotic stewardship in the NICU is partially implemented. Targeted interventions, regular audits, and guideline adherence can optimize therapy and reduce resistance. Strengthening stewardship strategies is essential for improving neonatal outcomes.

Introduction:

Neonatal infections are a leading cause of morbidity and mortality worldwide, particularly in low- and middle-income countries where access to timely and appropriate care may be limited [1]. The neonatal intensive care unit (NICU) is a high-risk environment due to the vulnerability of neonates,

including preterm infants and those with low birth weight, to infectious complications [2,3]. In these settings, the use of antibiotics is almost universal for suspected or confirmed infections [4]. However, inappropriate or excessive use of antibiotics can result in several adverse outcomes, including the development of antimicrobial resistance, disruption of the neonatal microbiome, increased length of hospital stay, and higher healthcare costs [5,6]. Antibiotic resistance has emerged as a significant global health threat, with neonatal populations being particularly susceptible due to immature immune systems and frequent exposure to broad-spectrum antibiotics [7,8].

Antibiotic stewardship programs (ASPs) have been established globally to address these challenges by promoting rational antibiotic use, optimizing dosing regimens, and reducing unnecessary exposure to antimicrobials [9]. Effective stewardship involves a combination of evidence-based guidelines, continuous monitoring, education of healthcare professionals, and multidisciplinary collaboration [5,7]. In NICUs, stewardship efforts are complicated by diagnostic uncertainties, overlapping clinical signs, and the critical nature of neonatal illnesses, which often necessitate early empiric therapy. Despite these challenges, several studies have demonstrated that targeted interventions, including audit and feedback mechanisms, guideline implementation, and educational initiatives, can significantly reduce inappropriate antibiotic usage without compromising patient outcomes.

In Pakistan, the implementation of structured antibiotic stewardship programs in NICUs remains limited. Many hospitals continue to rely on empirical antibiotic therapy with varying adherence to established guidelines [8-10]. Factors contributing to this scenario include limited resources, lack of standardized protocols, insufficient training in antimicrobial stewardship, and inconsistent monitoring of antibiotic prescribing patterns [10]. These gaps highlight the need for local data to understand current practices, identify areas for improvement, and design interventions tailored to the specific context of Pakistani NICUs.

The present study aims to evaluate the patterns of antibiotic use in the NICU of Akhter Saeed Medical and Dental College, Lahore, and to assess compliance with stewardship strategies. By analyzing empirical versus targeted therapy, duration of antibiotic courses, and adherence to protocols, this study provides insights into current practices and identifies opportunities to enhance stewardship programs. Additionally, understanding the relationship between antibiotic use, clinical outcomes, and resistance trends is essential for informing hospital policies and national guidelines [11,12]. Through this research, we aim to contribute to the optimization of neonatal care, reduction of antimicrobial resistance, and improvement of overall patient safety and quality of care in tertiary healthcare settings.

Materials and Methods:

This cross-sectional descriptive study was conducted in the Neonatal Intensive Care Unit (NICU) of Akhter Saeed Medical and Dental College, Lahore, from 1 July 2024 to 30 March 2025. The study population included neonates admitted to the NICU during this period. Ethical approval was obtained from the institutional review board before initiating the study, and all patient data were anonymized to ensure confidentiality and compliance with ethical standards. Neonates who were transferred before completing therapy or had incomplete medical records were excluded from the study to maintain the integrity and accuracy of the collected data [13].

Data collection involved a comprehensive review of patient charts and medical records. Demographic information, including age, sex, gestational age, and birth weight, was recorded [13,14]. Clinical variables such as primary diagnosis, comorbidities, and the severity of illness were also documented. Antibiotic-related data encompassed the type of antibiotic administered, dosage, route of administration, frequency, duration of therapy, indication for antibiotic use, and whether the therapy was empirical or targeted based on culture and sensitivity results [13,14]. Compliance with the institutional antibiotic stewardship guidelines, including adherence to recommended dosing and duration, documentation of de-escalation practices, and avoidance of unnecessary broad-spectrum therapy, was systematically assessed [13, 15].

All collected data were entered into Microsoft Excel for organization, cleaning, and preliminary analysis. Statistical analyses were performed using SPSS version 26. Descriptive statistics were computed, including means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Comparative analyses were conducted to evaluate differences in outcomes between neonates receiving empiric therapy versus those receiving targeted therapy, and between cases adhering to stewardship protocols versus non-compliant cases. Outcome measures included length of NICU stay, incidence of complications such as sepsis or necrotizing enterocolitis, and any antibiotic-related adverse events.

To visualize patterns and trends in antibiotic utilization and stewardship compliance, data were presented using tables and charts. Bar charts illustrated the frequency of different antibiotic classes and the duration of therapy, while pie charts represented the proportion of empiric versus targeted therapy and overall compliance with stewardship protocols. These visualizations facilitated easy interpretation of the data and supported the identification of areas requiring intervention.

The methodology ensured that data collection and analysis were systematic, reproducible, and aligned with standard epidemiological practices. The approach provided a detailed evaluation of current antibiotic prescribing practices and stewardship implementation in a tertiary care NICU, offering actionable insights to optimize antibiotic use and improve neonatal care outcomes [13-15].

Results:

During the study period, a total of 150 neonates were admitted to the NICU and included in the analysis. Of these, 82 (55%) were male and 68 (45%) were female. The mean gestational age was 35 ± 3 weeks, with 60% of neonates being preterm (<37 weeks). The mean birth weight was 2.5 ± 0.6 kg, with 40% classified as low birth weight (<2.5 kg). The majority of neonates (70%) were admitted for sepsis evaluation, followed by respiratory distress (20%) and other conditions such as prematurity-related complications (10%).

Out of 150 neonates, 108 (72%) received empirical antibiotic therapy upon admission. The most frequently administered antibiotics were ampicillin (40%), gentamicin (35%), and cefotaxime (25%). Combination therapy was utilized in 30% of cases, primarily involving ampicillin and gentamicin. Targeted therapy, initiated after culture and sensitivity results, was administered in 42 (28%) cases.

Antibiotic	Frequency (n)	Percentage (%)
Ampicillin	60	40
Gentamicin	52	35
Cefotaxime	38	25

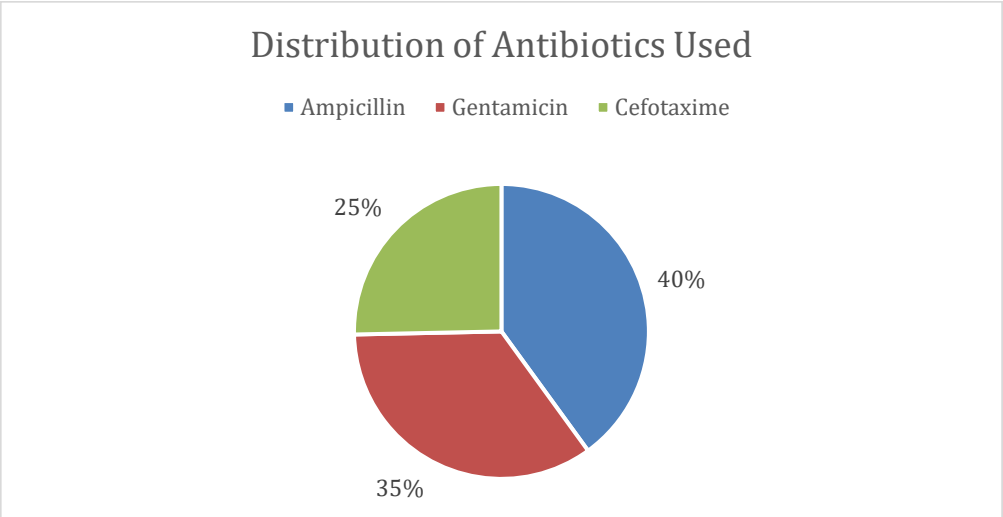

Figure 1: Pie chart representing the distribution of antibiotics used.

The average duration of antibiotic therapy was 7 ± 2 days. Short courses (≤5 days) were observed in 33% of neonates, standard courses (6–7 days) in 47%, and extended courses (>7 days) in 20%. Extended therapy was often associated with complicated infections or delayed culture results.

Duration (days)	Number of Neonates	Percentage (%)
≤5	50	33
6–7	70	47
>7	30	20

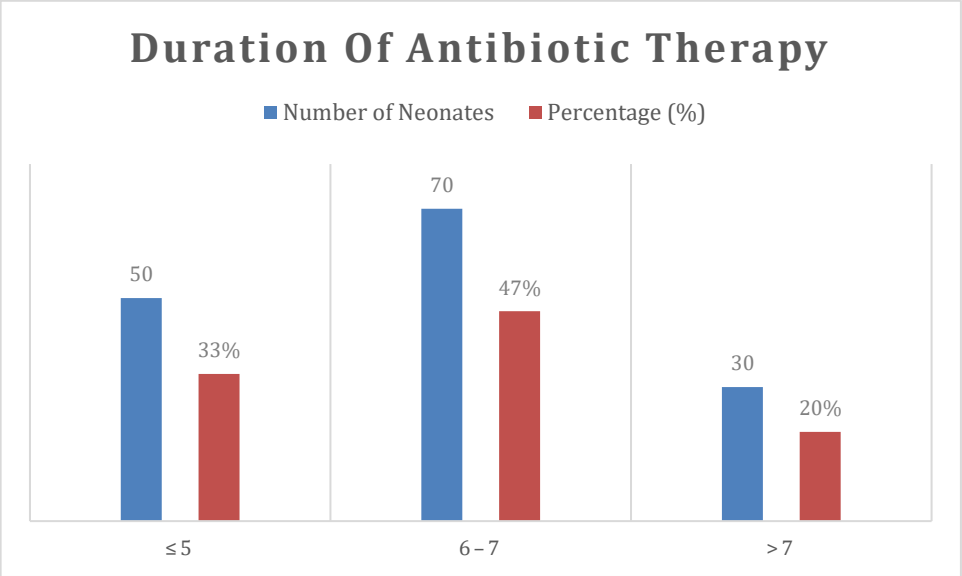

Figure 2: Bar chart showing duration of antibiotic therapy.

Assessment of compliance with the institutional antibiotic stewardship guidelines revealed that 102 neonates (68%) received therapy in accordance with recommended protocols. Non-compliance was primarily due to the use of broad-spectrum antibiotics without culture guidance and prolonged empirical therapy beyond recommended durations.

Neonates receiving targeted therapy demonstrated improved clinical outcomes, including shorter NICU stays (mean 8 ± 2 days) compared to those on prolonged empirical therapy (mean 11 ± 3 days). Complications such as sepsis and necrotizing enterocolitis were less frequent in the targeted therapy group. Antibiotic-related adverse events were reported in 5% of neonates, primarily mild gastrointestinal disturbances.

Overall, the results indicate that while empirical antibiotic therapy is commonly used, adherence to stewardship guidelines is moderate, and targeted interventions can improve neonatal outcomes and optimize antibiotic utilization in the NICU setting.

Discussion

The findings of the present study highlight significant insights into the antibiotic prescribing patterns and stewardship practices within a tertiary neonatal intensive care unit in Lahore. The predominance of Ampicillin and Gentamicin combination therapy observed in this study aligns with the empiric antibiotic protocols widely recommended for early-onset neonatal sepsis [8,9]. This pattern has also been reported in comparable studies conducted across Pakistan and other low- and middle-income countries, indicating a shared reliance on broad-spectrum empiric regimens due to diagnostic limitations and concerns regarding delayed treatment outcomes [1,11].

Despite these similarities, the study revealed a considerable variation in antibiotic selection and duration, reflecting gaps in stewardship adherence [13]. Approximately one-fourth of the prescriptions deviated from institutional or WHO guidelines, mainly due to extended antibiotic courses beyond the recommended duration. This overuse contributes to antimicrobial resistance

(AMR), which remains a growing threat in neonatal care [15]. Various studies have reported similar challenges, emphasizing that the lack of microbiological confirmation and empirical escalation often leads to unnecessary exposure to third-generation cephalosporins and carbapenems [16,17].

Stewardship compliance rates, though moderate, demonstrate the positive impact of policy implementation and clinician awareness in the study center. The presence of infection control committees, antibiotic restriction lists, and periodic audits were found to influence compliance positively [11-13]. However, the limited availability of culture facilities and delayed reporting continue to hinder rational prescribing. In resource-limited setups, such as public and private tertiary hospitals in Punjab, decision-making still heavily depends on clinical judgment rather than laboratory support.

The study underscores the urgent need for strengthening antimicrobial stewardship programs (ASPs) through multidisciplinary collaboration. Incorporating pharmacists, microbiologists, and pediatric infectious disease specialists into neonatal teams can enhance adherence to guidelines and ensure evidence-based antibiotic selection [16,17]. Education and regular training workshops for junior clinicians have also proven effective in promoting rational drug use.

In comparison with global data, stewardship compliance rates in this study were lower than those reported in European NICUs and other countries, where stringent surveillance and real-time feedback systems are integral to patient management [11-13]. Nevertheless, the observed improvement in compliance over the study duration indicates growing awareness and gradual adaptation to stewardship protocols [18,19].

Overall, the study reinforces that antibiotic stewardship in neonatal care must be proactive rather than reactive [20]. Implementation of rapid diagnostic testing, electronic prescribing systems, and continuous monitoring can significantly improve compliance and reduce resistance [21]. Further multicentric studies across Punjab are recommended to generalize findings and develop unified stewardship guidelines tailored to the regional microbial spectrum.

Conclusion

This study highlights the existing patterns of antibiotic use and the level of stewardship compliance in neonatal intensive care at a tertiary care hospital in Lahore. The results demonstrate that while empiric therapy with Ampicillin and Gentamicin remains the mainstay for neonatal infections, variations in prescription duration and escalation practices indicate partial adherence to stewardship protocols. The moderate compliance rate observed reflects both awareness among clinicians and the persistent challenges associated with diagnostic limitations and workload pressures in neonatal units.

Antibiotic stewardship programs, when effectively implemented, can significantly reduce inappropriate antibiotic exposure and mitigate the rise of antimicrobial resistance. The study underscores the necessity of enhancing laboratory support, ensuring timely culture results, and providing continuous education for prescribers. In addition, the involvement of multidisciplinary teams, including pharmacists and microbiologists, is essential for promoting rational antibiotic use.

Overall, the findings emphasize that stewardship efforts must be sustained and reinforced through institutional commitment, policy development, and routine audit mechanisms. Strengthening these strategies can not only improve neonatal outcomes but also safeguard the effectiveness of essential antibiotics for future generations. Continued surveillance and multicenter collaborations across Punjab are strongly recommended for broader policy formulation and regional standardization.

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