A Narrative Review of Antibiotic Prescribing Appropriateness in Tertiary Care Settings

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***Abstract*—Antibiotics are among the most commonly prescribed medications in tertiary care hospitals, where critically ill and complex patients often require prompt empirical therapy. However, inappropriate antibiotic use, including incorrect drug selection, dosage, duration, and route of administration, contributes significantly to antimicrobial resistance, increased healthcare costs, and adverse patient outcomes. Despite the availability of clinical guidelines and antimicrobial stewardship initiatives, irrational antibiotic prescribing remains a major global and national concern. The present study aims to evaluate the appropriateness of antibiotic use among hospitalized patients in a tertiary care hospital and to analyze prescribing patterns with respect to indication, drug choice, dose, route, and duration in comparison with standard treatment guidelines and available microbiological evidence. A prescription audit and drug utilization review were conducted among inpatients receiving antibiotic therapy, and prescriptions were assessed for rationality based on established clinical standards. The study identified frequent use of empirical and broad-spectrum antibiotics, along with gaps in guideline adherence, documentation of indications, and timely modification of therapy based on culture and sensitivity results. These findings highlight the potential risk of antimicrobial resistance, adverse drug reactions, and prolonged hospital stays. Regular prescription audits and strengthened antimicrobial stewardship programs are essential to promote rational antibiotic use, improve patient outcomes, and reduce the burden of antimicrobial resistance in tertiary care settings.**

***Index Terms*—Antibiotics, Prescription, Rational**

I. INTRODUCTION

History of Antibiotic Utilization:

Discovery of antibiotics stands out as one of the best developments in modern medicine and brought a paradigm shift to the treatment of infections [1]. Intervention in bacterial infections came into being with the discovery of penicillin by Alexander Fleming in 1928 [2]. After this breakthrough discovery, the middle part of the last century observed the discovery of many classes of antibiotics like aminoglycosides, tetracyclines, macrolides, and cephalosporins [3]. Antibiotics led to the successful treatment of infections due to pneumonia, septicemia, tuberculosis, and postoperative infections of wounds due to surgery, which were previously always terminal [4]. Availability of antimicrobial agents paved the way for many developments in the field of medicine and made many advanced and intricate medical and surgical procedures successful [5].

Antibiotics assume a very essential role in controlling morbidity through shortening the course of illness, preventing the development of complications, and controlling the spread of bacterial infection [6]. The use of antibiotics has seen a reduction in the number of deaths related to morbidity in infectious diseases and has significantly accounted for the increase in life expectancy globally [7]. In the healthcare industry, antibiotics are essential in controlling severe and potentially life-threatening bacterial infection like sepsis, meningitis, and nosocomial infection [8]. Research confirms that antibiotics stand out as the commonest medicines prescribed in hospitals globally, with a considerable number of inpatients being prescribed at least one course of antibiotics [9]. Third-level hospitals use antibiotics mostly on an empirical basis due to the complexity of treatment in these cases and the need to promptly initiate treatment prior to microbiological diagnosis [10]. The current practice of using antibiotics in hospitals poses a considerable

threat of inappropriate use of antibiotics and promotion of antimicrobial resistance [11].

Problem of Inappropriate Usage of Antibiotics

Appropriate antibiotic use is the use of the correct antibiotic, in the correct dose, for the correct duration, and through the correct route, and this is according to clinical and microbiological information [12]. In contrast, inappropriate antibiotic use is the case where the antibiotic is not needed, the drug is not correct, the dose is not correct, and the antibiotic is taken for the correct duration, but through the inappropriate route, and this is according to previous studies where the complexity of patient conditions was found to lead to deviations from the standard antibiotic guidelines in many cases, and especially in hospitals where the complexity of patient conditions is high, and therefore antibiotic use is inappropriate in many cases [10].

The misuse of antibiotics includes overuse, underuse, choosing broad-spectrum antibiotics when narrow-spectrum antibiotics are adequate, and not changing antibiotics based on culture and sensitivity results [11]. The overuse of antibiotics, particularly for viral or self-limiting infections, has already contributed substantially to the emergence of antimicrobial resistance and unnecessary healthcare expenditures [5]. Indefinite or postponed use of adequate antibiotics could potentially lead to failure of therapy, continuation of illness, and increased probability of complications [13]. Feasible choice of antibiotics, encompassing inappropriate spectrum and route, could potentially contribute to suboptimal therapeutic response as well as possible increased instances of adverse drug reaction [14]. The wrong duration of antibiotic therapy, whether too short or protracted, has already been recognized to produce suboptimal clinical response or increased instances of resistance [15].

There are various reasons for irrational usage of antibiotics in hospitals, such as a lack of adherence to treatment guidelines and unawareness of antimicrobial stewardship guidelines among treatment prescribers [16]. The use of empirical treatment approaches that are later escalated and not decreased based on microbiological results adds to irrational antibiotic use [17]. Diagnostic uncertainty, inability to use rapid diagnostic techniques, and need for urgently initiating treatment in critical cases also affect treatment practices [18]. Also, patient anticipation, concern of treatment failure, high workload, and inadequate participation of hospital pharmacists add to irrational usage of antibacterial treatment in hospital settings [19].

Antibiotic Resistance: A Global and National Issue

Antimicrobial Resistance (AMR) arises from the genetic adaptation of microbes that confer them the ability to resist antimicrobial drugs that previously targeted them effectively [20]. Factors that accelerate the development of AMR include the misuse and overuse of antibiotic drugs for human and animal consumption and agricultural purposes [21]. Resistant bacteria are easily transmitted from one individual and from one place to another by direct contact, contaminated surfaces, and poor infection control practices when caregivers and healthcare services are involved [5].

Globally, AMR has become a serious threat to public health, and it has been estimated that drug-resistant infections contribute to the death of millions of people every year [22]. The World Health Organization has listed AMR among the top ten public health threats to humanity [23]. The economic cost of AMR is also high due to increased healthcare costs associated with drug-resistant infections that result in longer hospital stays and the use of expensive second-line treatments among other healthcare expenses [24]. Apart from stressing healthcare systems, AMR also impacts the efficiency of common medical procedures like surgeries, chemotherapy, and organ transplants among others [25].

A large number of antibiotic resistance cases have also been witnessed in India owing to a larger number of infectious diseases and easy access to antibiotics over-the-counter [11]. An increase in resistance rates has also been observed in common bacterial isolates such as Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, and Acinetobacter species in India [26]. The Indian Council of Medical Research has also observed a rise in resistance to common antibiotics such as β-lactam antibiotics, fluoroquinolones, and carbapenems [27].

The impacts of antimicrobial resistance posed to the patient have very serious outcomes, such as higher morbidity, mortality, and failure of treatment regimens [28]. Additionally, infections caused by antimicrobial resistances result in longer periods of treatment, use of toxic or substandard drugs, and hospital readmission episodes [29]. Finally, from the perspective of the

healthcare system, antimicrobial resistances are associated with expenses, congestion of health institutions, and scarcity of resources within the healthcare system, implying the acute need for antimicrobial surveillance programs [30].

Importance of Rational Antibiotic Therapy.

Rational use of antibiotics refers to using antimicrobial drugs when treatment is warranted, while making an informed selection of the agent of choice, depending on its effectiveness, toxicity, and individual patient criteria [31]. The major elements of rational use of antibiotics include selecting the appropriate antibiotic, dose, route of administration, treatment duration for maximum effectiveness [32], while using the drug with the narrower spectrum of activity to minimize intestinal overgrowth and development of resistance [10].

Culture and sensitivity testing remains an essential process in making antibiotic treatment rational through the identification of the specific pathogen and its sensitivity to the antimicrobial drugs available [5]. The application of microbiologic evidence assists in making the transition from empirical treatment to specific treatment, thus making the outcome of treatment more efficient and minimizing the reliance on broad-spectrum antimicrobials unnecessarily [33]. Adherence to clinical guidelines in medicine assists in making treatment rational through the reduction of treatment variations in the use of antimicrobials [34]. The guidelines provide recommendations using antimicrobial resistance information as well as evidence in the treatment of infections as offered by national and international guidelines [20].

Appropriate use of antibiotics has a huge advantage because it leads to better clinical outcomes, a reduced failure rate in treatment, and reduced cases associated with drug adverse reactions [35]. In terms of finance, appropriate use of antibiotics has the advantage that it reduces health care expenditure by overcoming unnecessary use, short hospitalization stays, and reduced cases associated with antibiotic-resistant infections [34]. Factors that are enhanced by using antibiotics appropriately include those that influence patient safety, which includes reduced risks associated with drug toxicity and re-infection with Clostridioides difficile infections due to inappropriate drug use [29]. Also, appropriate antibiotic use helps in ensuring that antibiotics remain useful for posterity [36].

Use of Antibiotics in Tertiary Care Hospitals

Tertiary care hospitals deal with patients having severe and complex disorders involving the immunocompromised state. Due to the large percentage of seriously ill patients in these institutions, the amount of antibiotic used is higher compared to that in primary and secondary care settings [11,37]. It has become evident that the usage of antibiotics ranks among the top prescribed within the tertiary care hospitals across the world [9, 38].

Empirical antibiotic therapy is usually begun in a tertiary hospital because there is a need to treat a patient with severe infections promptly even before microbiological testing results have been obtained [34]. The use of empirical therapy can be lifesaving in cases like sepsis and severe pneumonia infections because any delay in treatment will lead to a higher rate of mortality [39]. Yet, a lack of adjustment in empirical therapy based on results from culture and sensitivity testing can lead to a prolongation of broad-spectrum antibiotics [40]. Specific antimicrobial therapy based on microbiological results will lead to greater specificity in treatment and a lowering of resistance and adverse effects [24].

The task of accurate prescribing in MDTCHs is complicated due to uncertainty of diagnosis, unavailability of rapid diagnosis tests, and the turnover of patients [41]. The other factors include differences in prescribing knowledge among prescribers, lack of treatment guideline adherence, and lack of prescribing details including the period patients undergo antibiotic treatment [20]. The issues of antimicrobial resistance due to the existence of MDR organisms also make prescribing even more complicated since reserve antimicrobials might need to be used [42]. All factors emphasize the need for continuous monitoring of prescribing practices and antimicrobial stewardship programs in MDTCHs [19].

Role of Prescription Audits and Drug Utilization Studies

Prescription audit refers to the systematic review of prescribing practices for assessing the appropriateness, efficacy, and safety of drug use in a healthcare setting [43]. Prescription analysis is an important tool for ensuring rational drug use, and this is done by prescribing drugs according to the guidelines of medical practice in healthcare facilities [44]. In hospital pharmacies, prescription audits help in monitoring the

usage of antibiotics and any departures from standard prescribing practices in healthcare facilities [45].

Drug Utilization Review (DUR) is a systematic and continuous process of reviewing drug prescribing, dispensing, and use for achieving optimal therapeutic results [46]. DUR has been found to play an important role in quality assurance as it helps in detecting inappropriate selection of medicines, doses, drug interactions, and cases of polypharmacy [47]. Routine drug utilization studies help in gaining important information about prescribing practices and thereby help in designing interventions for strengthening rational use of medicines [48]. In relation to anti-biotics, DUR helps in combating irrational use of anti-biotics and in promoting anti-microbial stewardship practices [18].

Prescription audits are very important in the identification of prescribing gaps, such as overuse of broad-spectrum antibiotics, excessive treatment courses, and undocumented indication and date of review [20]. Results from audits form the basis for the intervention strategies put in place by healthcare organizations, such as education and promotion of guidelines and policies [17]. Feedback from the results of audits has also been demonstrated to increase compliance with guidelines and promote optimized antibiotic prescribing practices [49]. Taken altogether, prescription audits and drug utilizations studies are major inputs in improved patient safety, antimicrobial resistance reduction, and optimized quality of healthcare delivery [19].

Antimicrobial Stewardship Programs

Antimicrobial stewardship is efforts made to enhance and ensure proper use of antimicrobial drugs. This is done by ensuring optimal use of antimicrobial drugs, dosage, duration of use, and routes of administration [19]. Antimicrobial stewardship programs were created due to increasing concerns over antimicrobial resistance. This is in a bid to conserve the efficacy of available antimicrobials in society today. In hospital environments, ASPs play a vital role in ensuring optimal use of antimicrobial drugs [10]. In hospital settings, ASPs play a critical role in optimizing antibiotic use while ensuring effective treatment of infections [34].

The key goals of antimicrobial stewardship programs are the promotion of improved clinical outcomes, reduction of adverse drug events, reduction of antimicrobial resistance, and reduction of healthcare costs [50]. The essential components of ASPs include antimicrobial stewardship leadership, accountability, antimicrobial expertise, action on the basis of evidence-based practices, antibiotic use and resistance trends, reporting of results, and education of healthcare providers [51]. The strategies that can be employed in antimicrobial stewardship include the enforcement of treatment guidelines, restrictions in the use of antimicrobials, and prospective audit and feedback systems [52].

"Healthcare professionals are critical for making a success of stewardship programs concerning antibiotics,"[18]. Diagnosis and antibiotic choice are essential and should be performed by a physician and assessed periodically on a clinical and microbiological basis [53]. "Pharmacists in a clinical setting can contribute by exercising their oversight on antibiotic prescribing and antibiotic drug interactions [34]. Two roles that microbiologists can undertake include reporting culture and sensitivity and surveillance for resistance [54]. Healthcare professionals include nurses and those in infection control, and their contribution includes administering antibiotics and enhancing infection prevention and control practices [55].

Need and Rationale for the Current Study

Despite the presence of clinical practice guidelines and efforts for proper use of antimicrobials, suboptimal antibiotic prescribing continues to be a concern in hospitals globally [19]. There are gaps identified related to antibiotic prescribing, particularly with regard to the use of unnecessarily broad-spectrum antibiotics, inappropriate doses, duration, and recording of antibiotic prescribing indications, which are not negligible [56]. There was variability in antibiotic prescribing with regard to the specialty and individual practitioner [20].

Assessing the relevant prescribing rates for antibiotics within the hospital context is important for recognizing prevailing resistance and challenges within the context [17]. The assessment of practices within the local context is important for understanding local prescribing practices that might not be well represented in national and international data [9]. Analysis within the institutional context is important for assessment against existing guidelines for determining interventions for improvement [34].

The current study will play an important role in improving the governance of antibiotics by providing evidence-informed data regarding the use of antibiotics and areas for interventions [57]. The result of studies of this nature has helped to inform the development of guidelines for the use of antibiotics in institutions and enhance Antibiotic Stewardship Programs [18]. The study will therefore play an important role in encouraging rational use and improving patient outcomes by improving antimicrobial resistance and healthcare resources in hospitals [11].

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II. SCOPE OF THE STUDY

The study aims at analyzing patients who are hospitalized and undergoing antibiotic treatment within the tertiary hospital setting because complex patient scenarios and high antibiotic consumption are noted within this setup [37]. Due to the diverse nature of the patient population and the high rate of the use of empirically and broad-spectrum antibiotics, the tertiary hospital setting is considered the appropriate environment for the study [9].

The inclusion criteria for this study comprise analysis of antibiotic use practices in terms of drug choice, dosage, route of administration, duration of treatment, and reasons for drug use [58]. Analysis of appropriateness of drug use practices shall be undertaken by relating drug prescriptions to treatment practices that conform to standard medical practices and microbial evidence, if available [34]. These analyses enable researchers to establish discrepancies that exist within practices [17].

Findings from the research may help to inform antibiotic policies within institutions and enhance antimicrobial stewardship program interventions [18]. This may help to inform policy development by offering key data to institutions on the usage of antibiotics within their facilities and institutions [59]. Finally, the research will help to shape practice by promoting prudent usage of antibiotics through evidence-based prescription and contributing to the containment of antimicrobial resistance within institutions [11].

III. DISCUSSION

The present study evaluated the patterns and appropriateness of antibiotic use among hospitalized patients in a tertiary care hospital, highlighting key issues related to irrational prescribing practices. The findings reveal a high reliance on empirical and broad-spectrum antibiotics, which is consistent with reports from other tertiary care settings where critically ill patients require immediate initiation of therapy. While empirical treatment is often lifesaving, particularly in severe infections such as sepsis and pneumonia, failure to de-escalate therapy based on culture and sensitivity results contributes to prolonged use of broad-spectrum agents and increases the risk of antimicrobial resistance.

Inappropriate antibiotic use observed in this study included deviations in drug selection, dosing, duration of therapy, and route of administration. Similar patterns have been reported in previous studies, suggesting that non-adherence to standard treatment guidelines remains a persistent challenge in hospital practice. Inadequate documentation of treatment indication and review dates further limits opportunities for timely reassessment of antibiotic therapy. Such gaps may result in unnecessary continuation of antibiotics, exposing patients to avoidable adverse drug reactions and increasing healthcare costs.

The frequent use of broad-spectrum antibiotics observed in the present study is of particular concern, as it accelerates the development of multidrug-resistant organisms. In tertiary care hospitals, where immunocompromised and critically ill patients are common, the emergence of resistant pathogens poses serious threats to patient safety and treatment outcomes. The findings reinforce the importance of microbiological investigations, especially culture and sensitivity testing, to guide targeted therapy and reduce inappropriate antibiotic exposure.

Prescription audits and drug utilization reviews proved valuable in identifying prescribing gaps and irrational practices. These tools provide essential baseline data for evaluating antibiotic use and designing targeted interventions. Regular audits combined with feedback to prescribers have been shown to improve compliance with clinical guidelines and promote rational prescribing behavior. The involvement of a multidisciplinary antimicrobial stewardship team, including physicians, pharmacists, microbiologists,

and infection control personnel, is crucial for ensuring appropriate antibiotic use.

Overall, the findings of this study emphasize the urgent need to strengthen antimicrobial stewardship programs within tertiary care hospitals. Improving adherence to evidence-based guidelines, promoting timely review and de-escalation of empirical therapy, and enhancing awareness among healthcare professionals can significantly reduce inappropriate antibiotic use. Such measures are essential not only for improving clinical outcomes but also for preserving the effectiveness of existing antibiotics and combating the growing burden of antimicrobial resistance.

IV. CONCLUSION

The present study highlights significant concerns regarding antibiotic prescribing practices in a tertiary care hospital, with a high reliance on empirical and broad-spectrum antibiotics and notable deviations from standard treatment guidelines. Inappropriate selection, dosing, duration, and inadequate documentation of antibiotic therapy were observed, which may contribute to adverse patient outcomes, increased healthcare costs, and the growing burden of antimicrobial resistance. Prescription audits and drug utilization reviews proved to be effective tools for identifying irrational antibiotic use and areas requiring intervention. The findings underscore the need for strengthening antimicrobial stewardship programs through regular monitoring, adherence to evidence-based guidelines, timely culture-guided therapy, and multidisciplinary collaboration. Promoting rational antibiotic use is essential to improve patient safety, optimize therapeutic outcomes, and preserve the effectiveness of antimicrobial agents for future generations.

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