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PRESCRIBING PATTERNS OFANTIBIOTICS USING WHO PRESCRIBING INDICATORS AMONG PEDIATRICS: A NEED FOR ANTIBIOTICS STEWARDSHIP PROGRAM

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Abstract: Background: Antibiotic resistance is a global public health issue caused by the irrational prescription of antibiotics. To combat this situation, it is essential to comprehend the pattern of antibiotic prescriptions. Antibiotic Stewardship Program (ASP) has become essential now, more than ever for maximizing the use of antibiotics to stop the formation of resistance and enhance patient outcomes during treatment. Objective: the objective of this study is to assess the pattern of antibiotic prescribing among pediatric inpatients, and to evaluate antibiotic prescribing practices using WHO core drug prescribing indicators. Materials and Methods: A prospective observational-based study was conducted for six months in a tertiary care hospital, Karachi. Results: in this study a total of 300 patients were included the antibiotics per prescription was 6.16 WHO standard is less than 26.83% antibiotics with an average of i.65 antibiotics per prescription. Out of 496 antibiotics 87.09% were injectable which is higher than WHO standard of 13.4-24.1%. from hospital formulary 99.39% antibiotics were prescribed which is similar to WHO standards. 68% of antibiotics were prescribed by generic names. Cephalosporin's and penicillin's were the most common class of antibiotic prescribed. Conclusion: In our study high use of injectable, polypharmacy and prescription with brand names were highlighted which can be overcome by implementing target educational interventions, support comprehensive antibiotic stewardship programs and Develop and implement national and local pediatric antibiotic prescribing guidelines based on WHO recommendations and local antibiotic resistance data.

Keywords: Antibiotic Resistance, Pediatric Antibiotics Practices, Rational and Irrational use, Prescribing Indicators, Antibiotic Stewardship, AWaRe Classification, WHO Prescribing Indicators.

INTRODUCTION

In the face of rising antibiotic resistance the vulnerable population which affect the most are the children. Because of the developing immune system of children,

they are highly susceptible to infections and this increased susceptibility is further exacerbated by the particular pharmacokinetic and pharmacodynamics factors in pediatric therapy[1]. This consequence of antibiotic resistance lead to severe prolonged illness, increased hospitalization and higher mortality rates. This circumstance emphasizes how urgently adapted measures are needed to maximize the usage of antibiotics in this age group[2]. In this global fight against antibiotic resistance (ABR) the crucial strategy has emerged which is antibiotic stewardship.

Antibiotics should be provided when there is a clear benefit. To slow down the development and resistance from antibiotics steward's programs help to overcome this [2] safeguarding the effectiveness of these essential medicines for future generations[3].This study focusses on Pakistan's distinctive background, particularly the province of Sindh and Karachi. Children health is directly impacted by the high prevalence of infectious illness and antibiotic resistance in this area.

WHO definition of rational medicine use

The World Health Organization (WHO) provide a standardized approach by developing a set of core drugs indicators for assessing and comparing patterns of drug utilization across different health care settings and countries. These metrics are intended to assess how well healthcare professionals work, how well patients interact with medical facilities, and how well medical staff members generally encourage the responsible use of medications. Of these, these prescription indicators are particularly concerned for evaluating the appropriateness of medications prescribing practices by health care providers[4].

Global and regional statistics on antibiotic misuse in children

The escalating risk of antibiotic resistance has been described as a "shadow pandemic," silently undermining our ability to deal with common infections, specifically in vulnerable populations like children[2].The international incidence of antibiotic-resistant bacteria causing infections in children is alarmingly high and keeps to upward push.1 Data from the WHO indicate that infections caused by multidrug-resistant (MDR) microorganism bring about approximately 700,000 deaths annually across every age, with round 200,000 of those deaths taking place in newborns[3]. In Europe, MDR infections may also account for up to 30% of pediatric cases. Regions within the Middle East have suggested even higher rates, with as much as 90% of newborns with sepsis in extensive care units having resistant microorganism[5]. Studies in South East Asia have found that a big percentage of children have E. Coli resistant against first-line antibiotics. These figures paint a regarding image of the enormous nature of antibiotic resistance in pediatric infections globally[6].

The high rates of antibiotics resistance found in numerous studies provide a particularly difficult scenario for Pakistan, specifically Karachi and Sindh province. According to a study conducted in Punjab, Pakistan, 82.1% of pediatric patients used antibiotics, and the vast majority (72.1%) of the medications that were provided under the WHO's Watch category[7].There may be a chance for further resistance development given the high usage of Watch antibiotics.

WHO prescribing indicators

There are five essential sections in the WHO/INRUD (International Network for Rational Use of Drugs) prescribing indicators for proper medication use[8].

Table:1 Summary of WHO Core Prescribing Indicators and Optimal Values

Indicator	Definition	WHO optimal value	Relevance to Antibiotic Stewardship
Average number of medicine per encounter	Total number of medicines prescribed divided by the number of prescription	1.6–1.8	Higher values may indicate polypharmacy, increasing the risk of drug interactions and potentially unnecessary antibiotic combinations.
Percentage of medicines prescribed by generic name	Total number of generic medicines prescribed/ divided by total number of prescriptions	100%	Promotes cost-effective prescribing and can reduce confusion, particularly important for ensuring access to affordable antibiotics.
Percentage of encounters with an antibiotic prescribed	Total number of encounters with one or more antibiotics prescribed/total number of encounters multiplied	20 26.8%	A high percentage may indicate overuse of antibiotics, potentially for viral infections or non-indicated conditions, contributing to antibiotic

	by 100		resistance.
Percentage of prescriptions with an injection prescribed	Total number of encounters with one or more injections prescribed/total number of encounters multiplied by 100	13.4 24.1%	Overuse of injectable antibiotics when oral formulations are appropriate can increase the risk of infections and other complications.
Percentage of medicines prescribed from essential medicine list	Total number of medicines from EML/total number of medicines prescribed multiplied by 100	100%	Reflects adherence to national drug policies and promotes the use of safe, effective, and affordable medicines, including appropriate antibiotics.

A developing frame of research demonstrates the effectiveness of ASPs in decreasing overall antibiotic use and inappropriate prescribing in pediatric settings, both in hospitals and outpatient clinics[9]. A systematic review of pediatric ASPs globally found that almost all included studies (79.6%) showed a significant reduction in inappropriate antibiotic prescriptions after ASP implementation[10].

WHO AWaRE classification

The WHO has created the Access, Watch, Reserve(AWaRe) classifications system for antibiotics in addition to these fundamentals prescribing factors. As a tool for antimicrobial stewardship, this method divides antibiotics into three groups according to their range of activity and susceptibility to resistance[11]. WHO aiming for at least 60% of all antibiotics consumptions to come from the Access group by 2023, it is imperative to track the percentage of antibiotics consumptions within AWaRe category[11]. This goal is to minimize the use of antibiotics that are more prone to cause resistance and to encourage the use of narrow spectrum antibiotics[11].

promoting the use of the WHO AWaRe classification system can manual antibiotic selection and monitoring efforts. Establishing antibiotic stewardship committees inside hospitals and clinics in Karachi, with devoted employees and resources, might be essential for leading and implementing stewardship tasks.

STUDY DESIGN AND PERIOD

A prospective observational-based study was conducted at a tertiary care hospital Karachi. Following an IRB approval, from The Holy Family hospital and from JUW (Jinnah University for Women) the study was conducted over six months to assess the antibiotic prescribing patterns among pediatrics using WHO core prescribing indicators.

Study Setting

The study was carried out on all patients who were hospitalized in the pediatric ward of the hospital was the source population in a tertiary care hospital Karachi, Pakistan.

Study Population

The study focused on pediatric population (aged 0-18 years) who admitted to the hospital during the data collection period.

DATA COLLECTION TOOL

The prescriptions were collected through a convenience sampling technique from the patient's medical record during the six-month study period on a special form which was designed for data collection from the pediatric ward. the collected prescriptions were evaluated as per WHO guidelines on prescribing indicators. containing the following parameters to evaluate the World Health Organization (WHO) core medication prescription indicators:

- The average number of medicines prescribed for each prescription.
- Average number of medications per prescription.
- Percentage of antibiotic-prescribed per encounter.
- The percentage of encounters with a prescribed injectable.
- The percentage of medicines prescribed from the National Essential Drug List or the facility's formulary.
- The percentage of medications prescribed by generic name.

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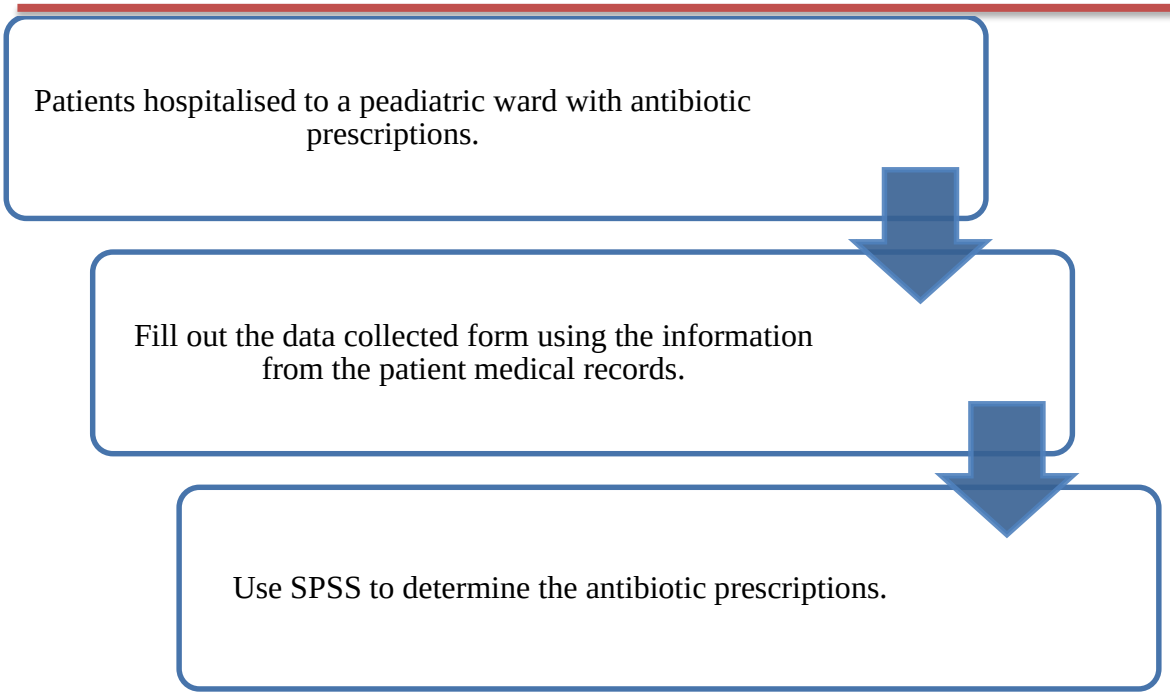


Figure 1: Diagrammatic Representation of Methodology

DATA PROCESSING AND STATISTICAL ANALYSIS

Data was collected over a period of six months from (November –April 2024-2025). Variables was coded, and the database was set. The IBM SPSS Statistics® was used to import the data and do statistical analysis. The study patients' sociodemographic and pertinent clinical features, as well as the pattern of antibiotic prescriptions, were compiled using descriptive statistics, which included mean and standard deviation for continuous variables and frequency and percentage for categorical variables. The amount of antibiotics prescribed and the prescribing trends were compared using confidence intervals (CIs). The WHO prescribing indicators' standard values were used to calculate, assess, and interpret the antibiotic prescribing patterns.

Ethical consideration

The research was done in a manner that met the Pakistan Pharmacy Council's code of ethics for the profession of pharmacist (PCP). Ethical approval was obtained from the Institutional Review Board of Jinnah University for Women. Additionally, access to the research location was requested and granted. The hospital authorities were also asked for permission to view patient records. Anonymity and confidentiality were guaranteed since no patient identifiers were noted. Data collecting procedure was managed in accordance with the privacy rules outlined in the professional code of ethics for pharmacists and health care professionals.

RESULTS

A summary of the study's findings follows the data analysis, which is covered in this chapter. The results are pertinent to the study's aims and objectives.

DEMOGRAPHICS AND PATIENTS CHARACTERISTICS

Patient Gender:

Two of the most important demographic factors to consider during rational prescribing are age and gender. A total of 300 pediatrics patients undergoing antimicrobial therapy.169 of them were males (56.3%). and 131 were females (43.7%).

Table 2: Gender Distribution of Pediatric Patients

Gender	Frequency	Percent
Male	**169(56.3%)**	**56.3%**
Female	**131(43.7%)**	**43.7%**
Total	**300**	**100**

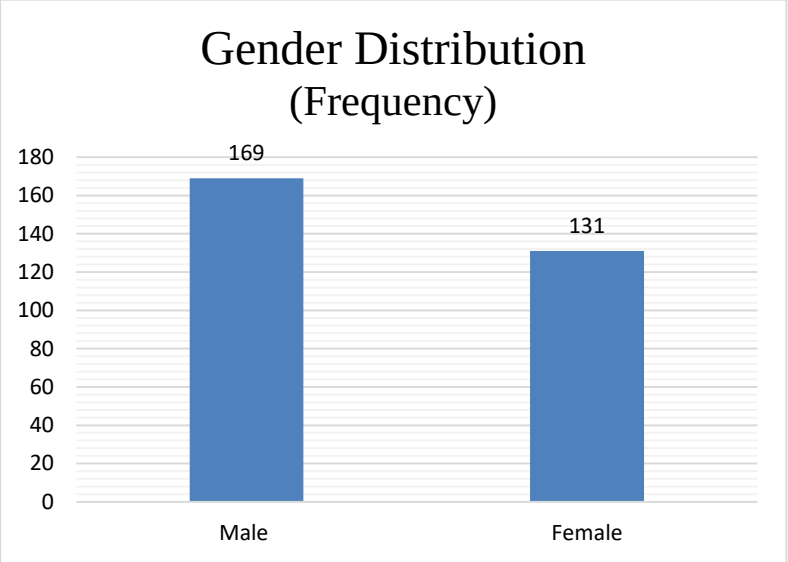


Figure 2: Gender Distribution of Pediatric Patients

Patient Age:

NICHD Pediatric Terminology, which was developed by the Eunice Kennedy Shriver National Institute of Child Health and Human Development in the United States, was used to categorize and modify the age stages of the patients for this study.

In this study 35.5% were infants, 7.7% were toddlers, 33.3% were early childhood cases, 14% cases were middle childhood and 9% were adolescence cases were identified. Among them the highest affected age group was 0-1 year of age.

Table 3: Age Distribution of Pediatric Patients

Demographic Characteristics of Pediatrics Age Groups (In Years)			
Stages	**Age Groups**	**Frequency**	**Percent**
Infants	0 month-1 year	107	35.50%
Toddlers	2-3 years	23	7.70%
Early children	4-9 years	100	33.30%
Middle childhood	10-13 years	42	14.00%
Adolescence	14 years-18 years	27	9.00%

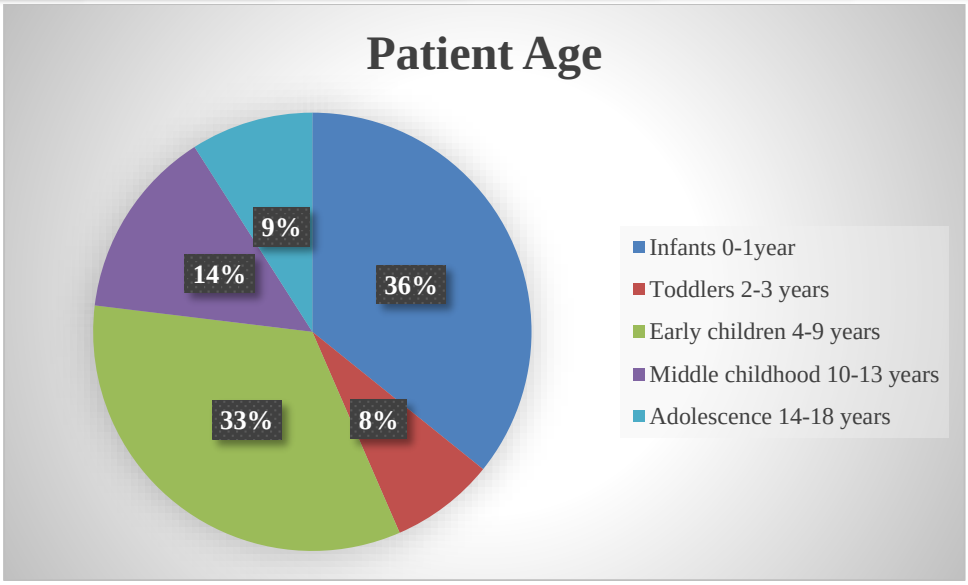


Figure 3: Age Distribution of Pediatric Patients

Pediatric Weight:

Weight is an important factor in the treatment of pediatric patients. Dosing errors are more likely to occur in this circumstance. Given this serious issue, a recent study conducted in the pediatric inpatient department of a tertiary hospital suggested that all the patient's body weight is included in prescriptions for all pediatric patients.

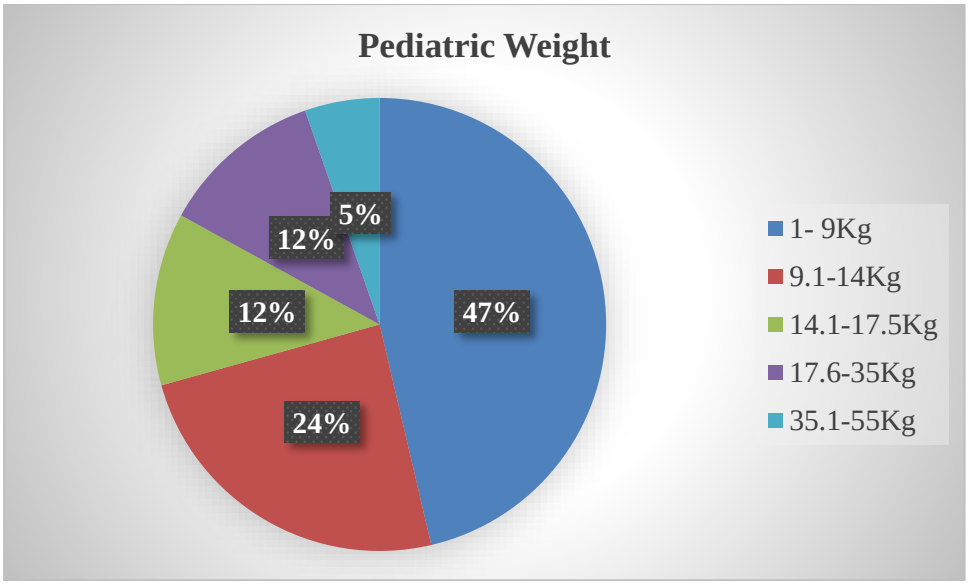


Figure 4: Pediatric Weight

Prevalence of Illness in Pediatric Patients:

The prevalence of infections was the highest in respiratory system was, 111(37%) followed by gastrointestinal infections, 97(32%) [table 2]. The highest antibiotic prescription was the cephalosporins (37%), followed by penicillin (20%) [table 3]

Table 4: Distribution of Illness in Pediatrics'

Cases	n(%)	Male n(%)	Female n(%)
Respiratory System	111(37%)	67(60%)	45(40.5%)
Gastrointestinal Infection	97(32%)	54(55.6%)	43(44.32%)
Urinary Tract Infection	53(17%)	26(49%)	27(50.9%)
Blood infection	15(5%)	8(53%)	6(40%)
Skin and Soft Tissue Infection	2(1%)	2(100%)	0(0%)
CNS Infection	11(4%)	6(54.5%)	5(45.45%)

Surgical Cases	2(1%)	0(0%)	2(100%)
Other Condition	9(3%)	3(33.33%)	6(66.66%)

DISTRIBUTION OF ANTIBIOTICS CLASS

In this study, the most commonly prescribed antibiotic classes were arranged from most commonly prescribed to least commonly administered. As mentioned before, antibiotics were used in this study. It was found that this study prescribed a total of antibiotic classes when the analysis was done by antibiotic class. The figure below displays an overview of the statistics for the antibiotic classes that are most frequently administered.

Out of 496 antibiotics prescribed cephalosporin's prescribed 37%. Followed by penicillin's 20%, macrolides 13%, nitromidazole 11%, tetracycline 7%, quinolones 6%, carbapenem 3% then aminoglycoside 2%, lincosamide 1% and glycopeptide 0.4%. in this study cephalosprins were the highest prescribed and glycopeptide was the lowest prescribed antibiotic.

Table 5: Distribution of Antibiotics Class in Pediatrics

Antibiotics	n%
Cephalosporins	188 (37%)
Penicillin	98 (20%)
Macrolides	63 (13%)
Nitronimidazole	56 (11%)
Tetracyclines	34 (7%)
Quinolones	31 (6%)
Carbapenem	13 (3%)
Aminoglycoxide	8 (2%)
Lincosamide	3 (1%)
Glycopeptide	2 (0.4%)

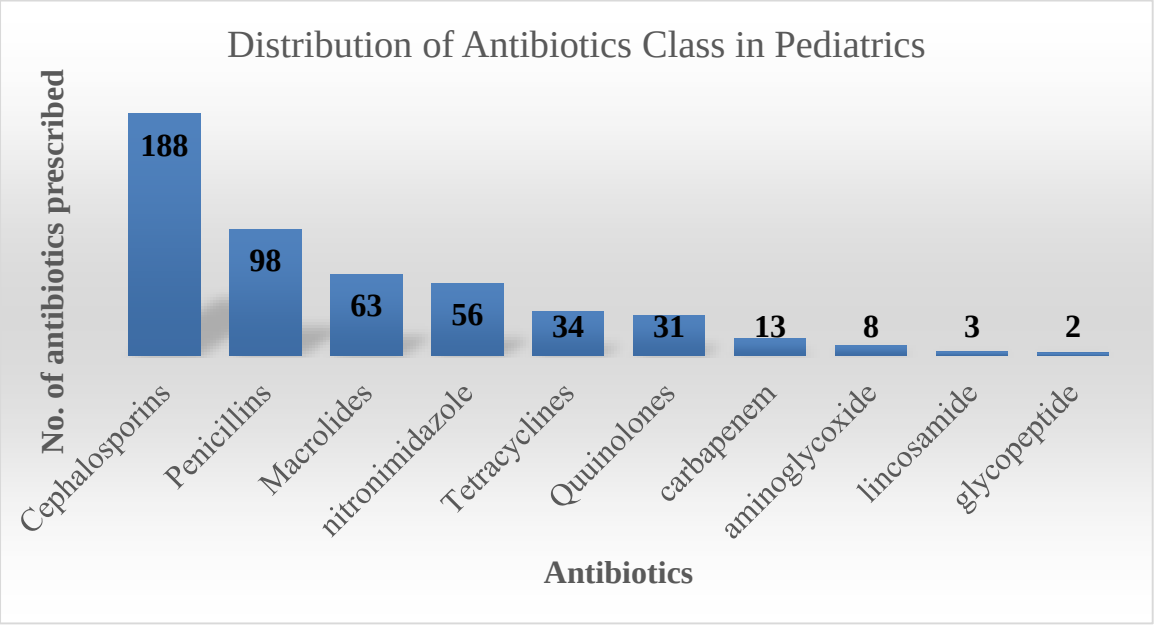


Figure 5: Distribution of Antibiotic class in pediatrics

WHO PRESCRIBING INDICATORS

WHO prescribing indicators A total of 1849 drugs were prescribed with an average of 6.16% per patient. The percentage of antimicrobial prescribed was 26.83% with an average of 1.65 per prescription. Most of the antibiotics were targeted at respiratory tract infections. Of the 496 Antibiotics prescribed 87.09% were injectable, 68.14% were prescribed with generic name and 99.39% of antibiotics were prescribed from the local hospital formulary.

Table 6: WHO Core Prescribing Indicators

	WHO Core Prescribing Indicators		
	Indicators	**Percentage(n)**	**standard(%) of WHO**
1	Average number of drugs per encounter	6.16% (1849)	<2
2	Percentage of encounters with an antibiotic prescribed	26.83% (496)	20-26.8
3	Percentage of encounters with an injection prescribed	87.09% (432)	13.4-24.1
4	Percentage of drugs prescribed by generic name	68.14% (338)	100
5	Percentage of drugs prescribed from the Essential Medicine List(EML)	99.39% (493)	100

Number of Medications: out of total 1849 drugs prescribed by pediatrics some patients received the combination of four, five, six, seven and eight medications the average number prescribed was a combination of six medications per prescription which should be less than two.

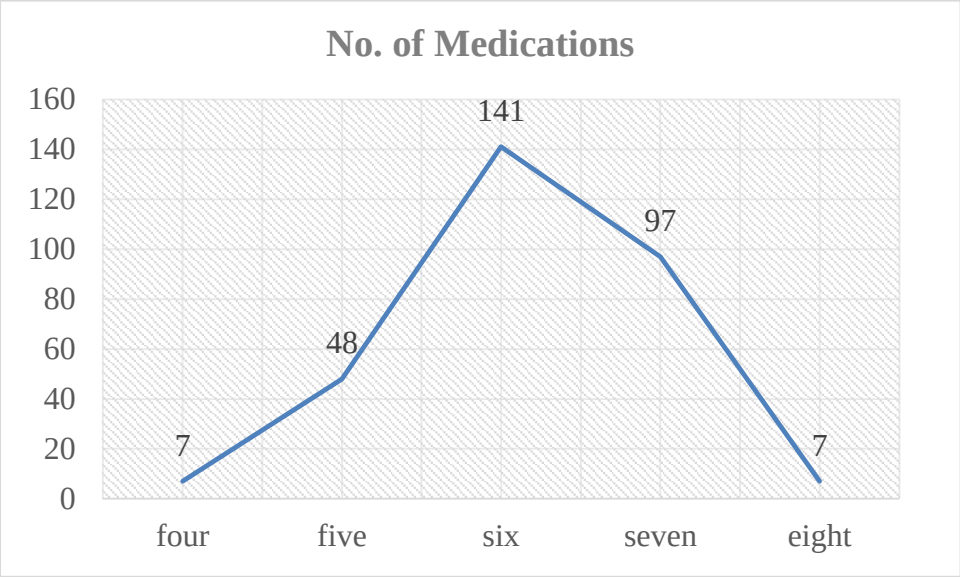
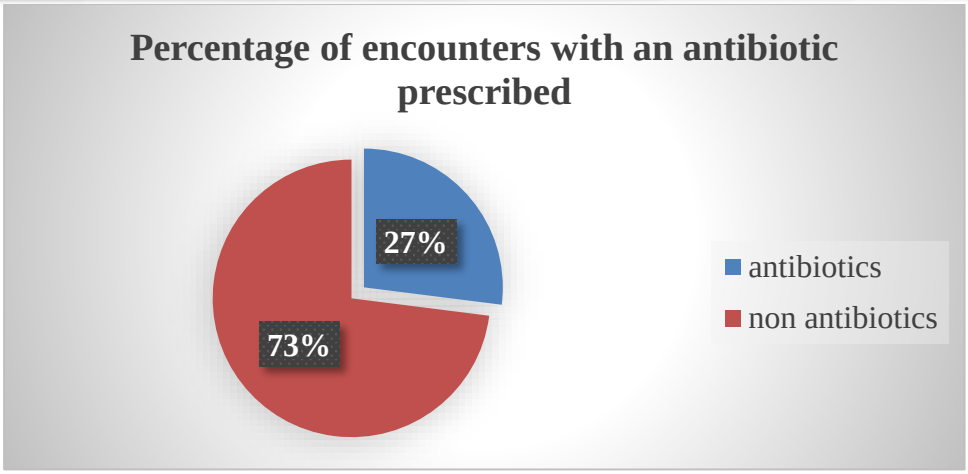


Figure 6: No. of Medications

Total Antibiotic Prescribed: total 1845 medicines prescribed out which 496 antibiotics were prescribed. In our study the proportion of antibiotics prescriptions are 26.83 with an average of 1.65 per encounter within the WHO'S recommended range20-26.8%.



Injection Prescribed: out of 496 total antibiotics percentage of encounters prescribed with an injection 87% (432), In our study antibiotics, antipyretics, antimalarial, IV fluids, antiprotozoal, gastro protective, Diuretics, electrolyte supplement were administered respectively.

Figure 7: Total Antibiotic Prescribed

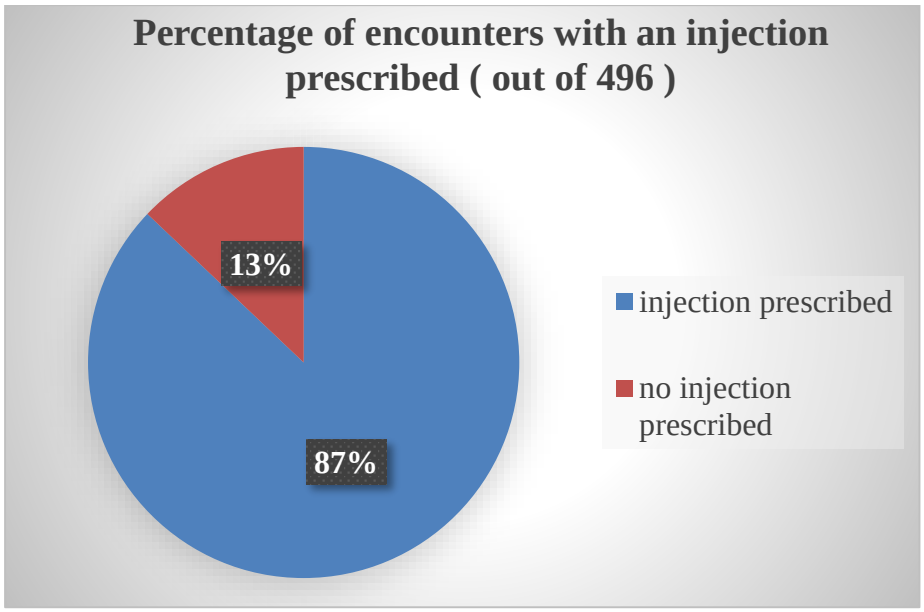


Figure 8: Percentage of Injection Prescribed

Drugs Prescribed by Generic Names: out of 496 68% antibiotics were prescribed generic names. WHO recommended value for prescribing drugs by generic name was 100%, our study reported 68% which is higher because by prescribing by branded name it not only increase treatment costs but also increase of dispensing errors.

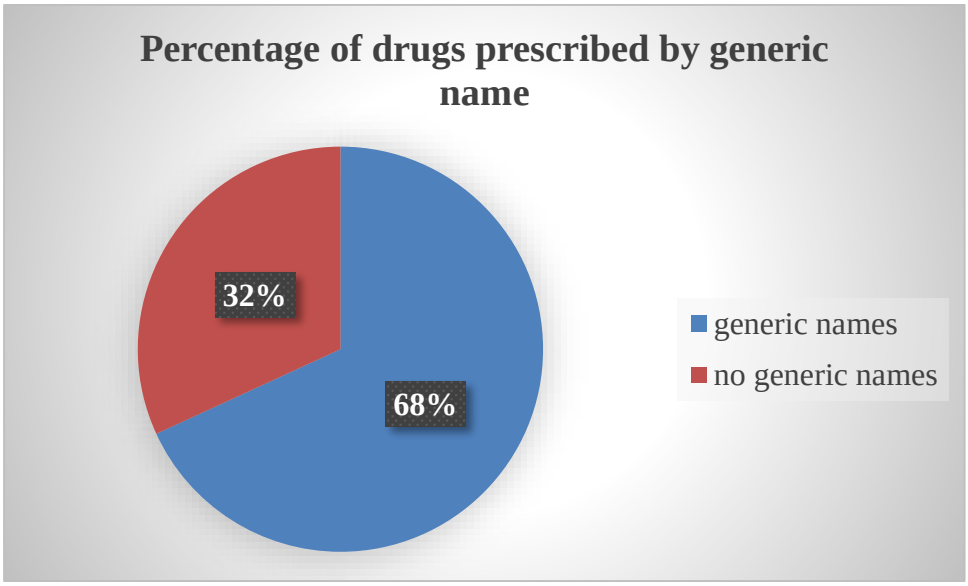


Figure 9: Percentage of Drugs Prescribed by Generic Names

Drugs Prescribed from Essential Medicine List (EML): 99.93% antibiotics prescribed from EML. Pakistan Essential Medication List (EML) act as a national framework for selecting and appropriately utilizing medications that fulfil the key health care requirements. It guarantees the accessibility of safe, effective and affordable medications across all healthcare levels.in accordance with national standards our results comply with these standards that are included in Pakistan EML. This approach encourages the sensible use of medications, advances fairness in access to crucial therapeutic agents and aids in the execution of uniform treatment guidelines.

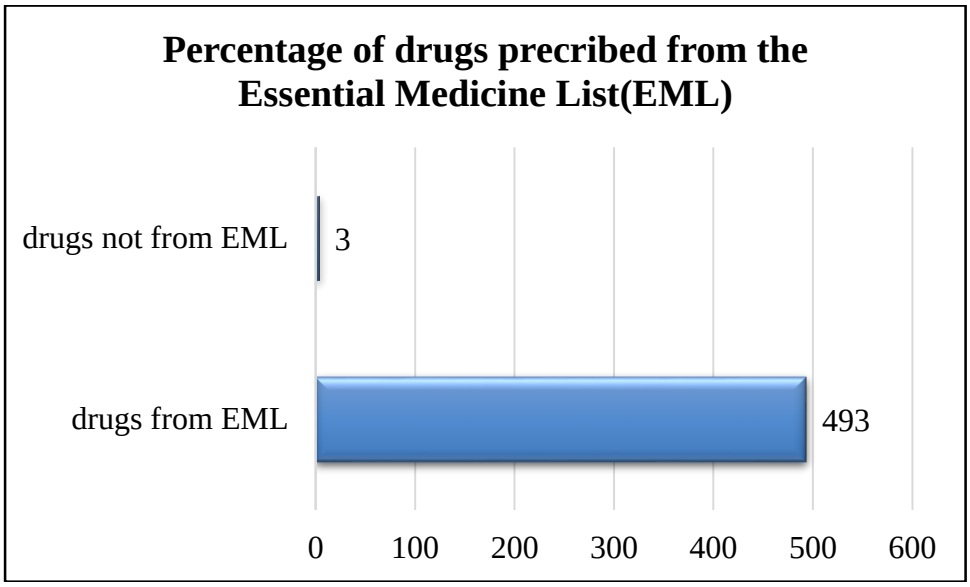


Figure 10: Drugs Prescribed from Essential Medicine List (EML)

Antibiotics in WHO AWaRe groups for children:

In our study most of the antibiotics are from the access and watch group and very few antibiotics are from the reserve group.

The prescribing patterns or the predominance of antibiotics from the Access and Watch groups in the hospital formulary reflects a rational and guideline based approach to antimicrobial use. For the common infections antibiotics as the first and second line treatments from the WHO Access group are recommended due to their safety

profile, efficacy and low potential in antimicrobial resistance. WHO recommended that at least 60% of total antibiotics consumptions should be from the Access group and alignment with this indicates the WHO stewardship goals.
Watch group antibiotics should be used when Access group may be effective for specific indications. Watch group antibiotics have higher resistance potential and requires close monitoring.

It is also a positive indicator if the Reserve group presence is limited as they are used for multidrug resistant infection and are last resort options which should be used under specialist guidance and strict stewardship. Our results portray a significance results and adherence with the WHO recommended AWaRe classification and it should be follow which help to reduce the emergence of resistance.

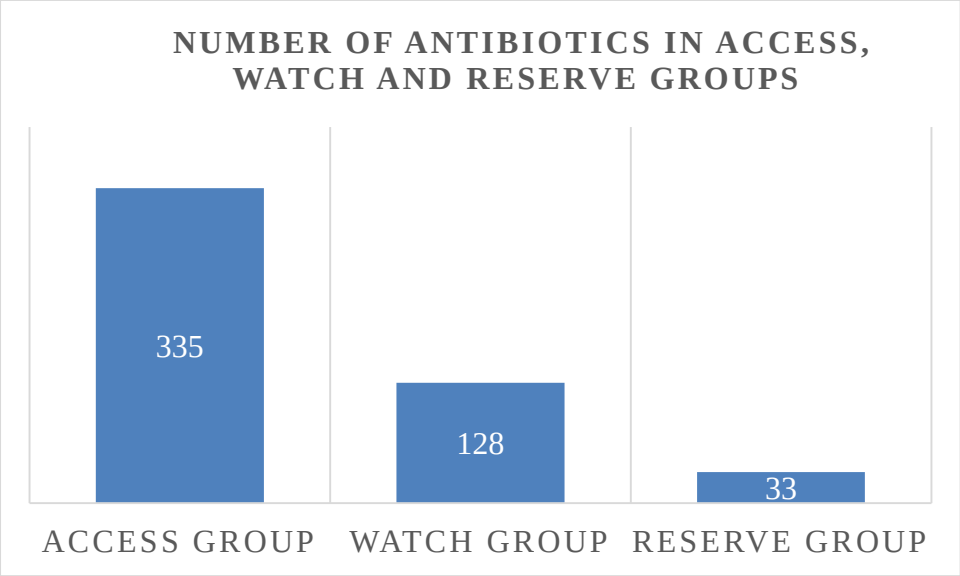


Figure 11: Number of Antibiotics in Access, Watch and Reserve groups

DISCUSSION

This chapter presented the findings and analysis of a study that examined the prescribing practices of antibiotics among healthcare providers on a pediatric department. The study initially presented and examined the results of the analysis of patient demographics and characteristics. Our study identified a male predominance in pediatrics encounters 56.3% with similar results reported in Northern Nigeria, India Ethiopia and Sierra Leone(12).(13) This higher representation of male children in hospital based studies is often due to the cultural norms, particularly resource limited regions that prioritize male children for health care access a pattern observed in South Asian regions.(12) In terms of age distribution, our study found higher use of antibiotic among infants aged 1month to 12 months (35.5%) this is because of immature immune system which are highly vulnerable to infections and higher exposure of risk. Same evidences found in Nepal and Sierra Leone where infants under one year are under the high rates of antibiotics prescriptions.(14, 15) (14, 15) Respiratory tract infections (RTIs) as disease prevalence emerged as the most common diagnosis in low and middle income countries that due to poverty, poor sanitation, overcrowding, malnutrition and environmental exposures such as air pollution which affects the children badly.in resource limited environments that are more prone to RTIs. In comparison to other diagnosis, respiratory disorders were the most often diagnosed illnesses for which antibiotics were prescribed.
Unfortunately, the study was unable to identify the precise etiology of this detected illness since culture tests were not performed on the majority of treated individuals. The study concludes that in this instance, medical professionals gave antibiotics without establishing a link between the sickness and the treatment. The study's conclusions showed that the majority of the conditions for which antibiotics were prescribed were based on empirical judgements, that the majority of the conditions for which antibiotics were prescribed had no evidence of the infectious organism, and that the prescription of antibiotics was only occasionally related to the interpretation of sensitivity or culture results.
Our study's findings of 6.16 drugs per patients encounters highlights the issue of polypharmacy, which is higher than the WHO target of 1.6-1.8 drugs per encounter (16) Numerous studies conducted worldwide contexts have identified similar patterns of polypharmacy. Inconclusive diagnoses or pressure on physicians to prescribe medications for minor symptoms lead to increased risks of side effects, drug interactions, the development of antibiotic resistance,

and higher costs.(17) additionally, polypharmacy was aided by the treatment of people with multiple conditions.

In our study the proportion of antibiotics prescriptions are 26.83 with an average of 1.65 per encounter within the WHO'S recommended range20-26.8%. This finding closely aligns with data from Nigeria, which report 28.2 % of an antibiotic prescribing rate which is higher than the WHO'S benchmark.(18) similarly in the UAE it was 44.6% (18)

Use of injectable are sometimes necessary, our study reveals the use of injectable that was significantly much higher than the WHO's recommended range of 13.4%-24.1%, which raise concerns about the risk of blood borne infections, complications and higher cost. High injectable use was due to the factors that include the limited availability of oral formulations in pediatrics, non-compliance with oral formulations and urgency in some medical conditions.(18) Wide variations show globally in injectable prescribing: one study reported in India an injectable use of 2.2% and in Nigeria it was recorded 10.2% which was below the WHO's range.(13, 19) By contrast an Ethiopia documented an alarming injectable rate of 84.33%.(18)

WHO recommended value for prescribing drugs by generic name was 100%, our study reported 68% which is higher because by prescribing by branded name it not only increase treatment costs but also increase of dispensing errors. On the other hand, generic prescribing is more economical, simplifies the supply chain, and it also enhances transparency between the health care provider and patients. Studies from India reported generic prescribing 25.76% which was low (18), in Sierra Leone it was 71% considerably high stronger adherence to WHO's rational drug use guidelines.(20)

In our study from hospital formulary antibiotic prescribed was 99.39% which was very close according to the standard of 100% by WHO which indicates a strong adherence to rational prescribing practices, as prescribing from the Essential Drug List (EDL) which ensures cost effectiveness, evidence based and well tested medicines. In Nigeria similar results were reported in which there was 60.4% hospital formulary compliance and in UAE it was 100% reflecting strong adherence.(21, 22) In our study the most cases were the upper respiratory tract infections(URTIs) and acute gastroenteritis (AGE). Out of 300 patients 165 patients receive the monotherapy of antibiotics, 45 patients receive the dual therapy and 90 patients receive the poly therapy. Antibiotic classification within the WHO Essential Medicines List (EML) has recently undergone a significant modification. Limiting antibiotic choices through the use of formularies will save money for the patient, the clinic, and the government while also reducing hospital flora exposure to a broad range of antibiotics. As a result, the public sector's policy includes the implementation of EDLs and STGs. Formularies are developed in the private sector. Most notably, the STGs and EDL are part of the country's 'Essential Drugs Concept,' and are regarded as crucial aspects of national health policy. Expert committees compile and study data to resolve issues regarding medication affordability and accessibility in primary care and hospital settings. They also have guidelines for rational antibiotic prescribing in the case of antibiotics. The EDL includes generic drugs that are criterion-based and stratified for primary and secondary treatment, as well as for adult and pediatric patient guidance.

CONCLUSION

The purpose of the study was to examine trends in the prescription of antibiotics by medical professionals in the pediatric ward of a tertiary care hospital in Karachi. The results show certain deviation from WHO prescribing indicators, particularly with the increased use of injectable medications, indicating the need for closer monitoring of antibiotic use. However, the majority of medications followed the hospital formulary. The overall percentage of antibiotics prescribed use is rational. To improve prescribing practices, It is advised that ongoing education and training initiatives be implemented for doctors to improve the rational application of injectable and generic prescriptions.

Further it was recommended that clinical pharmacist should be assign in all ward in order to review prescriptions and provide appropriate suggestions where necessary. Based on the findings of this report, the following actionable recommendations are proposed for healthcare administrators, policymakers, and healthcare professionals in Pakistan, particularly in Sindh province and Karachi, to improve antibiotic prescribing practices and promote the successful implementation of antibiotic stewardship programs in pediatric settings.

Establish antibiotic stewardship committees within healthcare centers in Karachi and Sindh to champion and oversee the implementation of stewardship initiatives. These committees must consist of representatives from numerous disciplines, along with pediatrics, infectious diseases, pharmacy, and microbiology.

BIBLIOGRAPHY

1. Yu D, Zheng Y, Shen A, Wu F, Dmitriev AV, Kilian M, et al. Antimicrobial resistance in pediatric infectious diseases: antimicrobial resistance, resistance mechanisms and antimicrobial use. Frontiers Media SA; 2023. p. 1287051.
2. O'Neill J. Tackling drug-resistant infections globally: final report and recommendations.

2016.
3. Jee Y, Carlson J, Rafai E, Musonda K, Huong TTG, Daza P, et al. Antimicrobial resistance: a threat to global health. 2018;18(9):939-40.
4. Ofori-Asenso R, Brhlikova P, Pollock AMJBph. Prescribing indicators at primary health care centers within the WHO African region: a systematic analysis (1995–2015). 2016;16:1-14.
5. Laxminarayan R, Matsoso P, Pant S, Brower C, Røttingen J-A, Klugman K, et al. Access to effective antimicrobials: a worldwide challenge. 2016;387(10014):168-75.
6. Region A, Region S-EA, Region EM, Region WPJMM. Global action plan on antimicrobial resistance. 2015;10(9):354-5.
7. Aqeel,A., Jabeen, S., Kainat, T., Ahmed, M., Ahmad, I., Azhar., Arain, H., & Khanam, Y. (2025). Role of Microbial Contaminants in the Development of Malnutrition in Pediatric Patients with Gastrointestinal Diseases. Frontier in Medical & Health Research .Volume 3, Issue 8.
8. Aqeel, A., Mirani, Z. A., Bawa, M. Y., Asif, S., Noor, R., Khan, S., & Abbas, T. (2021). Perceptive on bacteriological quality in foods of animal origin sold in the local market: Potential threats for the perishable food supply chain. International Journal of Endorsing Health Science Research (IJEHSR), Vol. 9 No. 4 (2021).
9. Sheikh S, Saleem Z, Afzal S, Qamar MU, Raza AA, Haider Naqvi SZ, et al. Identifying targets for antibiotic stewardship interventions in pediatric patients in Punjab, Pakistan: point prevalence surveys using AWaRe guidance. 2025;12:1469766.
10. El Mahalli AJEMHJ. WHO/INRUD drug prescribing indicators at primary health care centres in Eastern province, Saudi Arabia. 2012;18(11):1091.
11. Aqeel, A., Amin, A., Sultan, Q. A., Yousaf, I., & Fatima, K. Microbial contamination of street food vendors'hands: Prevalence of staphylococcus aureus and other pathogens.The Research of Medical Science Review .2025Volume 3, Issue 10.
12. Weragama K, Mudgil P, Whitehall JJA. Paediatric antimicrobial stewardship for respiratory infections in the emergency setting: A systematic review. 2021;10(11):1366.
13. Donà D, Barbieri E, Daverio M, Lundin R, Giaquinto C, Zaoutis T, et al. Implementation and impact of pediatric antimicrobial stewardship programs: a systematic scoping review. 2020;9(1):3.
14. Aqeel, A., Abbas, T., Mirani, Z. A., Naveed, T., Ahmed, N., & Basit, A. (2021). Seasonal Variation in Microbial Contamination of Various Food Items in Karachi: Microbial Contamination of Various Food. Biological Sciences-PJSIR, 64(1), 75-80.
15. Mugada V, Mahato V, Andhavaram D, Vajhala SMJTjops. Evaluation of prescribing patterns of antibiotics using selected indicators for antimicrobial use in hospitals and the access, watch, reserve (AWaRe) classification by the World Health Organization. 2021;18(3):282.
16. Umar LW, Isah A, Musa S, Umar BJAoAm. Prescribing pattern and antibiotic use for hospitalized children in a Northern Nigerian Teaching Hospital. 2018;17(1):26-32.
17. Aqeel, A., Amin, A., Sultan, Q. A., Yousaf, I., & Fatima, K. Microbial contamination of street food vendors'hands: prevalence of staphylococcus aureus and other pathogens. The Research of Medical Science Review .Volume 3, Issue 10, 2025
18. Bassoum O, Ba MF, Sougou NM, Fall D, Faye AJP. Evaluation of prescribing indicators in a paediatric population seen in an outpatient consultation at the Gaspard Kamara Health Centre in 2019 (Senegal). 2021;9(2):113.
19. Sapkota K, Sah AK, Thapa RB, Thapa Y, Dangi S, Adhikari RKJSOP. Morbidity and drug prescribing pattern in pediatric outpatient Department of Kankai Nagar Hospital of Eastern Nepal. 2025;12:30502225251319878.
20. Ali, S. F. A., Masroor, S., Shaikh, M. K., Jabeen, G., Naz, S. A., Aqeel, A., & Anjum, K. (2026). Biogenesis of Candida glabrata-Mediated Silver Nanoparticles: Characterization and Antibacterial Effectiveness Against Human Pathogenic Bacteria. International Journal of Molecular Sciences, 27(3), 1263
21. Kamara IF, Fofanah BD, Nuwagira I, Kamara KN, Tengbe SM, Abiri O, et al. Assessment of antimicrobial stewardship programmes and antibiotic use among children admitted to two hospitals in Sierra Leone: a cross-sectional study. 2024;13(1):80.
22. Atif M, Azeem M, Sarwar MR, Shahid S, Javaid S, Ikram H, et al. WHO/INRUD prescribing indicators and prescribing trends of antibiotics in the Accident and Emergency Department of Bahawal Victoria Hospital, Pakistan. 2016;5(1):1928.

