

A Prospective Study on Cephalosporin Utilization by Pattern in Pediatric Patients

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Abstract: Pediatric is the medicine specialization concerned with the health of infants, children, and adolescents. Worldwide, many infectious diseases were controlled in the 20th century by improving living standards, public health, and various antimicrobial agents. Antibiotics, in particular, cephalosporin, are amongst the most widely dispensed medications in Pediatric departments worldwide, especially in countries where there are no strict guidelines to regulate their use. A prospective cross-sectional study was conducted at 150 Bedded Pediatric ward of Peoples University of Medical and Health Sciences for Women (PUMHSW), Nawabshah, Shaheed Benazirabad to assess the utilization pattern of cephalosporin among all admitted in-patients. Patients' demographic details were recorded from the Patient's Bedside File (PBF). Data were analyzed by using Microsoft Excel and Microsoft SPSS 20. Among all admitted patients, 1285 patients met the inclusion criteria, and their PBF were evaluated for cephalosporin. A total of 2863 antibiotics were prescribed among 1932 patients. The most commonly prescribed class of antibiotics among the study population was Cephalosporin 1971 (68.83%), followed by Cefotaxime (20.39%). 76.20% of pediatric patients were prescribed antibiotics through the parenteral route and 23.8% through the oral route. The most common diagnosis was Pneumonia (23.4%), diarrhea (11.6%), and Bronchitis (11.2%), following other indications. Antibiotics were being prescribed without national antibiotic guidelines or institutionally approved protocols, which are currently unavailable. The study findings shall help the hospital administration and government design and implement official policies to promote rational utilization of antibiotics.

Keywords: pediatrics, cephalosporins, antibiotics, consumption pattern, culture sensitivity test.

儿科患者头孢菌素使用模式的前瞻性研究

摘要: 儿科是医学专业, 关注婴儿、儿童和青少年的健康。在世界范围内, 通过提高生活水平、公共卫生部门和使用各种抗菌药物, 许多传染病在 20 世纪得到了控制。抗生素, 特别是头孢菌素是全世界儿科最广泛使用的药物之一, 特别是在没有严格的指导方针来规范其使用的国家。在沙希德·贝娜齐拉巴德的纳瓦布沙的人民医科大学的 150 个床位儿科病房进行了前瞻性横断面研究, 以评估所有住院患者中头孢菌素的使用模式。从患者的床边档案中记录患者的人口统计细节。使用擅长表和微软社会科学统计软件包 20 对数据进行分析。在所有入院患者中, 1285 名患者符合纳入标准, 并对其 PBF 进行了头孢菌素评估。在 1932 名患者中, 总共开了 2863 种抗生素。研究人群中最常用的抗生素是头孢菌素 1971 (68.83%), 其次是头孢噻肟 (20.39%)。其中, 76.20% 的儿科患者通过胃肠外途径开具抗生素处方, 23.8% 通过口服途径开具抗生素。最常见的诊断是肺炎 (23.4%)、腹泻 (11.6%)

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和支气管炎 (11.2%) 以及其他适应症。抗生素的处方没有任何国家抗生素指南或机构批准的协议, 目前在该国是不可用的。研究结果将有助于医院管理部门和政府制定和实施促进抗生素合理使用的官方政策。

关键词: 儿科, 头孢菌素, 抗生素, 消费模式, 培养敏感性试验。

1. Introduction

Pediatric is the medicine specialization concerned with the health of infants, children, and adolescents. Worldwide, many infectious diseases were controlled in the 20th century by improving living standards, the public health sector, and various antimicrobial agents [1]. Our atmosphere is equipped with deadly microorganisms [2], which leads to the cause of different infections. As the geriatric population, the pediatric populations are also at high risk of infection [3]. The occurrence of highly infectious diseases is seen in pediatric patients due to multiple microbes present in the environment. Furthermore, the inadequacy of immunity is also reported in the first few years of life [4]. Globally, antibiotic consumption has been low in high-income countries but disproportionately high in low- and middle-income countries. According to a recent study that extended the analysis to 2015, the consumption rates for cephalosporins, quinolones, and macrolides decreased in high-income countries. They increased in low- and middle-income countries [5].

Antibiotics are amongst the most widely dispensed medications in Pediatric departments [6] in both community and hospital settings, all over the world, especially in countries where there are no strict guidelines to regulate their use. Irrational prescription is a global problem, and it may lead to unsafe treatment, exacerbation of the disease, health hazards, and economic burden of disease [7]. One of the robust social problems facing the health care system is Antimicrobials Resistance, even though many reports, literature on antimicrobial misuse, irrational antimicrobial prescribing practices, and inappropriate consumptions have been pronounced [8]. Many infectious organisms have adjusted to the drugs and become ineffective or less effective. The World Health Organization (WHO) reported that resistance of bacteria had achieved a threatening level in different parts of the world [9]. Antimicrobial resistance is referred to as "the insensitivity of microorganism against an antimicrobial agent." Acquired type resistance is developed by the overuse of antibiotics [10]. Therefore, there has been a growing worldwide concern about antimicrobial resistance's clinical and economic impact. Hence, it is necessary to work for the appropriate use of antibiotics to eliminate an increasing pattern of antibiotic resistance worldwide [11, 12].

2. Methodology

2.1. Study Setting

A prospective cross-sectional study was conducted at 150 Bedded Pediatric ward of Peoples University of Medical and Health Sciences for Women (PUMHSW), Nawabshah, Shaheed Benazirabad. This department is entitled to pediatrics facilities such as Pediatric Emergency, Neonatal ICU, Pediatric Surgery, and Nursery. This hospital caters facility of in-patients from surrounding districts such as Sanghar, Nausharoferoz, Moro, Dadu, and Matiari.

2.2. Study Population

In-patient under 12 years of age, admitted in any pediatric wards of PUMHSW Nawabshah, Shaheed Benazirabad Hospital.

2.3. Inclusion Criteria

Pediatric/Neonatal In-patients prescribed Cephalosporins alone/or in combination and were admitted for at least 24 hours as in-Patient.

2.4. Exclusion Criteria

All those patients who were not meeting the inclusion criteria were excluded from the study.

2.5. Data Collection

After having attained informed assent form from parents, the patients were recruited in the study for reviewing their medication records. In-depth interviews were also conducted after taking consent from Concerned Health Care Professionals. Patients' demographic details like age, gender, complications at admission, and final diagnosis were recorded from the Patient's Bedside File (PBF). The prescribed pattern of cephalosporins was recorded. The prescriptions were categorized based on prescribed antibiotics; Ceftriaxone, Cefotaxime, Ceftazidime, and Cefixime alone or in combination. After admission, the initial therapy was recorded and categorized into Empirical, Prophylactic, and Targeted (without Culture Sensitivity Test) after consultation with prescribing Physicians/Consultants. The status of CST was recorded. The report of CST was followed by the Pathology Laboratory of the hospital [13].

2.6. Data Analysis

Details of drug therapy such as the name of the drug, dosage form, frequency, route of administration, duration of treatment, type of therapy (Empirical, Targeted or Prophylactic), length of hospital stay, and

the number of drugs per prescription were recorded from the patients' bedside files. Data were analyzed by using Microsoft Excel and Microsoft SPSS 20. Descriptive statistics were applied to analyzed data, and results were expressed as mean, proportions, and standard deviations. Descriptive analysis included frequency, means, and standard deviation.

This study was approved by the "Ethical Review Committee" of the Ziauddin University (Reference code 3740521AAPHA, June 29, 2021.)

3. Results

Data were collected from 150 Bedded Pediatric wards of Peoples University of Health and Medical Sciences for Women University Hospital Nawabshah, Benazirabad from mid of June 2021 to mid of Nov 2021. The pediatric ward is divided into Pediatric Surgery, Neonatal ICU, Pediatric Emergency Department, and Pediatric Nursery. A total of 3736 patients was admitted to the Pediatric ward. Among those, 1285 patients met the inclusion criteria, and their PBF were evaluated for cephalosporins. The demographic details of the patients are shown in Table.1. There were more male child patients than female child patients, (n=698, 54.32 %) and (n=587, 45.68%) respectively. The mean age of all the patients was 3.85 +4.26 years, and their average weight was 6.42± kg. Children less than 12 months had the highest occurrence (n=480, 37.37%), 1year to 5 years occurred n=427, 33.28%, 5years to 12 years occurred n=378, 29.34%.

Table.1 Gender-wise distribution

Variable	Proportion	Percentage
Male	698	54.32 %
Female	587	45.68 %
01 Year ≥ 12 months	480	37.37%
01 Year ≥ 05 Years	427	33.28%
05 Years to 12 years	378	29.34%

The average Duration of Therapy was 5-7 days. CST test was performed for 53 patients (4.12%). The average number of antibiotics per prescription was found to be 1.45+0.53.

3.1. Prescribing Pattern of Antibiotics

A total of 2863 antibiotics were prescribed among 1932 patients. The most commonly prescribed class of antibiotics among the study population were Cephalosporins in 1971 (68.83%), followed by Cefotaxime (20.39%). Most common antibiotics utilized also depend upon the available resources, as sometimes in Government Hospitals, especially some antibiotics get short due to delay in Government medicines supplies. In the present study, most of the drugs are given parenteral doses. Out of 2863 antibiotics prescribed, 2182 (76.20%) drugs were given through the parenteral route, and 681 (23.8%) drugs were given through the oral route. Table. 2 illustrates class-wise utilization of antibiotics prescribed among pediatric patients.

Table 2. Utilization of Antibiotics

Class	Drug	N (percentage)
Cephalosporins 1971 (68.83%)	Ceftriaxone	1331 (67.52)
	Cefotaxime	584 (29.62)
	Ceftazidime	38 (1.94)
	Cefixime	18 (0.92)
	Ampicillin	202 (7.05)
Penicillins 296 (10.33%)	Amoxicillin/Clavulanate	35 (1.22)
	Piperacillin/Tazobactam	59 (2.06)
	Ciprofloxacin	121 (4.23)
Fluoroquinolones 128 (4.47%)	Levofloxacin	07 (0.24)
Macrolides 40 (1.40%)	Azithromycin	40 (1.40)
Aminoglycosides 1 (2.14%)	Amikacin	61 (2.14)
Carbapenems 151 (5.28%)	Meropenem	151 (5.28)
	Linezolid	38 (1.33)
Others 216 (7.55)	Vancomycin	178 (6.22)
	Total	2863 (100)
Type of Therapy		
Single Antibiotic Therapy	1927 (67.3%)	
Double Antibiotic Therapy	864 (30.2%)	
Triple Antibiotic Therapy	72 (2.5%)	
Total	2863 (100%)	
Route of Administration	Percentage	
Parenteral	76.20	
Oral	23.80	
Type of Therapy	Percentage	
Empirical	1232 (95.88)	
Targeted	53 (4.12)	

3.2. Indication of Therapy Used

During the study time, the most common diagnosis was Pneumonia (23.4%), followed by diarrhea (11.6%)

and Bronchitis (11.2%), following other indications. The details of the indications treated with antibiotics are summarized in Table 3.

Table 3. Indication for Therapy Used

Diagnosis	Number	Percentage
Pneumonia	670	23.4
Diarrhea	332	11.6
Common Cold	237	8.3
Bronchitis	321	11.2
Tonsillitis	103	3.6
Gastritis	255	8.9
Meningitis	52	1.8
Urinary Tract Infections	280	9.8
Continuation of Table 2		
Sepsis	80	2.8
Enteric Fever	34	1.2
Others	499	17.4
Total	2863	100

3.3. Type of Cephalosporins

Among Cephalosporins, 67.52 % of patients have been prescribed Ceftriaxone, 29.62 % Cefotaxime Sodium, 1.94% Ceftazidime, and 0.92 % Cefixime.

3.4 Duration and Type of Antibiotic Therapy

The average day frequency of antibiotic therapy was found to be 5.68±1.18 days. Most patients (65.7%) received antibiotic therapy for 5 days, while 18.3% have dispensed antibiotics for 7 days. Single antibiotic therapy was received by 67.3% of the patients, while 30.2% of patients were given a double antibiotic regimen and 2.5% of the patients received triple antibiotic therapy, respectively. The details are summarized in table 2.

4. Discussion

This study was designed to evaluate the cephalosporins utilization pattern in pediatric units of a tertiary care Teaching Hospital. A total of 1285 eligible children in-patients were recruited, and their therapy was evaluated from the Patient's Bedside File (PBF) concerning cephalosporin utilization. Overall, their mean age was 3.85 ± 4.26 years. Children under 12 months had the highest occurrence (n=480, 37.37%). These results are similar to a similar study by Choudhury and Bezbaruah [14] in India, where the highest number of children in the study were age group less than one year. Thapliya et al. [15] also conducted a study that added more acceptance to the results that the pediatrics below 1 year dispensed antibiotics more often than elder children. These findings may be suggested by the possibility that below 01-year pediatrics are more susceptible to infection than the elder children, and male pediatrics are supposed to have more chances of being infected than the female. Among the 1285 cases that met the inclusion criteria, more male child patients were than female child patients (n=698, 54.32 %) and (n=587, 45.68%), respectively. Similar results were reported by Khaled et al. [16], Girma et al. [17], and many other previous findings are concurrent to these observations [18, 19].

The eminent utilization of cephalosporins in our study is similar to findings in other evaluations where cephalosporins in common (and Ceftriaxone in particular) were among the more often prescribed antibiotics [20, 21]. Non-confined use of third-generation cephalosporins could increase *Escherichia coli* and *Klebsiella pneumonia* resistance.

The study was conducted in Southern Ethiopia, wherein Achalu et al. [22] reported 90.17% of injectable antibiotic administration among pediatric patients, while in Palestine [23], the same type of study found 61.8% injectable administration. This study suggests 76.20 % of the antibiotics were administered through the parenteral route of administration, which is in close resemblance to the study conducted in Nigerian tertiary hospital by Anyanwu and Arigbe- Osula that reported 80– 86% parenteral route of administration [24]. Report of Bishoflu hospital, India [3] accounted for 83.1 % of parenteral route administration. In Pakistan, parenteral antibiotic administration was reported as high as 96% [25]. World Health Organization (WHO) allows only 13.4 to 24.1% of injectable prescriptions for health care setup.

Overall, third-generation Cephalosporins were the most prescribed class of antibiotics 66.57% Table 2, in the pediatric unit, particularly Ceftriaxone (46.5%), and the second-most dispensed drug was the Cefotaxime (20.39%). The third generation class is prescribed more often because of its response to a wide range of bacteria. These findings accord some old studies [3, 17, 26] that reported cephalosporin as the most frequently prescribed class of antibiotic in the pediatric unit.

It was observed that mostly empirical therapies were prescribed. In government hospitals, delay in diagnosis or non-availability of CST facility or delay in the report was the possible cause of empirical therapy. That is in line with the study reported by Prabahar et al. [27], where the majority of prescriptions suggesting antibiotics were issued on the empirical basis that is without proper diagnosis; Casey and Pichichero also suggested that the antibiotics prescribed without diagnosis or suspected diagnosis were more than 50% amid in-patients pediatrics [28]. Cephalosporins are more prioritized than Penicillins as cephalosporins were proven more beneficial in bacteriologic and clinical cures were significantly more likely than Penicillin [28]. Another reason for the Cephalosporin priority over penicillin is the increased report of allergic reactions with penicillin, as some patients are hypersensitive to penicillin.

As per the study of Achalu et al., 22.8 % of cases were prescribed with a single antibiotic, and two antibiotics were prescribed in 51.5% of cases [23]. A single antibiotic was prescribed in 67.3% of cases in our study. Multiple antibiotics were prescribed in 32.7 (double and triple antibiotic therapy) % of patients, according to the study of Shivaleela et al., and this was comparable to the studies of [14, 29] (29%). Out of

32.7% of cases, 29.5% had more than 2 antibiotics only 2.7% cases had three antibiotics. In the present study, the most common route of antibiotic administration was the I.V route (76.20%), followed by the oral route (23.8%). The same study was done by Shivaleela et al. [29]. This study was conducted on admitted cases, so the most common route of administration was the I.V route.

5. Conclusion

The present study reveals that the antibiotic utilization was higher than the developed countries; the most commonly prescribed antibiotic class was cephalosporins and penicillin in Pediatrics. Overall, third-generation Cephalosporins were the most prescribed class of antibiotics 66.57% in the pediatric unit, particularly Ceftriaxone (46.5%). The second most dispensed drug was Cefotaxime (20.39%). The most common diagnosis was Pneumonia (23.4%), followed by diarrhea (11.6%) and Bronchitis (11.2%), following other indications. It was observed that there was overutilization of antibiotics in an injectable form that had raised the treatment cost. A culture sensitivity test was not performed for most cases (95.88%) before antibiotics prescribing. From available data, this can be concluded that antibiotics were being prescribed without any official national antibiotic guidelines or institutionally approved protocols, which are currently available in the country. The novelty of this study is that no such study was conducted in public sector hospitals of interior Sindh in In-Patients Pediatrics before this study. The study findings shall help the hospital administration and government design and implement official policies to promote rational utilization of antibiotics. The Limitation of this study was that the duration of the study was 06 months, and the hospital selected for the data do not use computerized prescription; therefore, some prescription may be missed during evaluation. Further studies on different hospitals for longer periods may be conducted in the future using WHO prescribing protocols. It is recommended that the government immediately address the irrational and overuse of antibiotics by implementing national antibiotics policy, antibiotics stewardship programs, and training the healthcare staff.

References:

[1] MALPANI A. K., WAGGI M., RAJBHANDARI A., KUMAR G. A., NIKITHA R., and CHAKRAVARTHY A. K. Study on prescribing pattern of antibiotics in a pediatric out-patient department in a tertiary care teaching and non-teaching hospital. *Indian Journal of Pharmacy Practice*, 2016, 9(4), 253. <https://doi.org/10.5530/ijopp.9.4.7>

[2] MISHRA H., MISHRA R., and MONDAL A. Prescription pattern of antimicrobial drugs in pediatrics outpatient department of a tertiary care teaching hospital of North India. *International Journal Basic & Clinical Pharmacology*, 2014, 3(2), 385-388. <https://www.ijbcp.com/index.php/ijbcp/article/view/441>

[3] FELEKE, M., YENET W., and LENJISA J. L. Prescribing pattern of antibiotics in pediatric wards of Bishoftu Hospital, East Ethiopia. *International Journal Basic & Clinical Pharmacology*, 2013, 2(6), 718-722. <http://dx.doi.org/10.5455/2319-2003.ijbcp20131209>

[4] STEINBERG I. Pediatric infectious disease. In: KODA-KIMBLE M. A., YOUNG L. Y., (Eds.) *Applied therapeutics: The clinical use of drugs*. 9th ed. Wolter Kluwer Philadelphia, 2009, 1-19.

[5] KLEIN E. Y., VAN BOECKEL T. P., MARTINEZ E. M., PANT S., GANDRA S., and LEVIN S. A. Herman Goossens, and Ramanan Laxminarayan. Global increase and geographic convergence in antibiotic consumption between 2000 and 2015. *Proceedings of the National Academy of Sciences of the USA*, 2018, 115(15), E3463-E3470. <https://doi.org/10.1073/pnas.1717295115>

[6] HARRISON R. F., & OUYANG H. Fever and the rational use of antimicrobials in the emergency department. *Emergency Medicine Clinics*, 2013, 31(4), 945-968. <https://doi.org/10.1016/j.emc.2013.07.007>

[7] BABY B., DAS S., HAQUE I., and SHERIEF H. A Study on Prescribing Pattern of Antibiotics for Respiratory Tract Infection in Pediatric Outpatient in A Tertiary Care Hospital: A Prospective Observational Study. *International Journal of Pharmaceutical Sciences Review and Research*, 2019, 59(1), 30-33. https://www.researchgate.net/publication/337414001_A_Study_on_Prescribing_Pattern_of_Antibiotics_for_Respiratory_Tract_Infection_in_Pediatric_Outpatient_in_A_Tertiary_Care_Hospital_A_Prospective_Observational_Study

[8] MURAKI Y., YAGI T., TSUJI Y., NISHIMURA N., TANABE M., NIWA T., WATANABE T., FUJIMOTO S., TAKAYAMA K., MURAKAMI N., and OKUDA M. Japanese antimicrobial consumption surveillance: first report on oral and parenteral antimicrobial consumption in Japan (2009-2013). *Journal of Global Antimicrobial Resistance*, 2016, 7, 19-23. <http://dx.doi.org/10.1016/j.jgar.2016.07.002>

[9] WORLD HEALTH ORGANIZATION. *Antimicrobial resistance: Global report on surveillance*, 2014. <https://apps.who.int/iris/handle/10665/112642>

[10] TIPATHI K. D. *Essentials of medical pharmacology*. 7th ed. Jaypee Brothers Medical Publishers, New Delhi, 2013, 688-700.

[11] DESALEGN A. A. Assessment of drug use pattern using WHO prescribing indicators at Hawassa University Teaching and Referral Hospital, south Ethiopia: A cross-sectional study. *BioMedCentral Health Services Research*, 2013, 13, 170. <https://doi.org/10.1186/1472-6963-13-170>

[12] LI Y., XU J., WANG F., WANG B., LIU L., HOU W., FAN H., TONG Y., ZHANG J., and LU Z. Overprescribing in China, driven by financial incentives, results in very high use of antibiotics, injections, and corticosteroids. *Health Affairs (Millwood)*, 2012, 31(5), 1075-82. <https://doi.org/10.1377/hlthaff.2010.0965>

[13] FATIMA R., BAIG M. T., ARSALAN A., SHAHID U., JABEEN A., ALI M. M., SHAHNAZ S., SHAIKH, S., MIRZA A. S., and KHAN S.A. Irrational Use of Quinolones in Tertiary Care Hospital Karachi, Pakistan. *International Journal of Medical Research & Health Sciences*, 2020, 9(8), 9-12. <https://www.ijmrhs.com/medical-research/irrational-use-of-quinolones-in-tertiary-care-hospital-karachi-pakistan.pdf>

[14] CHOUDHURY C. K., & BEZBARUAH B. K. Antibiotic Prescription pattern in pediatric in-patient department

Guwahati medical college and hospital. *Journal of Applied Pharmaceutical Science*, 2013, 3(8), 144–148. <http://dx.doi.org/10.7324/JAPS.2013.3825>

[15] THAPLIYA K., SHRESTHA S., SHEELA B., DAMODAR B., and CHAUDHARY R. K. Prescribing pattern of antibiotics in pediatric hospital in Chitwan district in Nepal. *World Journal of Pharmacy Pharmaceutical Science*, 2015, 4, 1641–1641. <https://www.imedpub.com/articles/prescribing-pattern-of-antibiotics-in-pediatric-hospital-in-nepal.pdf>

[16] KHALED M. A., & ANSARI A. Prescribing pattern of antibiotics in pediatric patients in the Jazan Region, Kingdom of Saudi Arabia. *Rajiv Gandhi University of Health Sciences Journal of Pharmaceutical Sciences*, 2014, 4(3), 106–119. <http://dx.doi.org/10.5530/rjps.2014.3.6>

[17] GIRMA S., SISAY M., MENGISTU G., AMARE F., and EDESSA D. Antimicrobial Utilization Pattern in Pediatric Patients in Tertiary Care Hospital, Eastern Ethiopia: The Need for Antimicrobial Stewardship. *Hospital Pharmacy Journal*, 2017, 53(1), 44–54. <http://dx.doi.org/10.1177/0018578717737429>

[18] SHAMSHY K., BEGUM I. M., and PERUMAL P. Drug utilization of antimicrobial drugs in pediatrics population in a tertiary care hospital in Erode, Tamilnadu, India. *International Journal of PharmTech Research*, 2011, 3, 1530–1536. <https://www.semanticscholar.org/paper/Drug-Utilization-of-Antimicrobial-drug-in-in-a-care-Shamshy-Perumal/394d878b2b7d5246a6de552a92b7733f6e6d37c6>

[19] WOLDU M. A., SULEMAN S., WORKNEH N., and BERHANE H. Retrospective study of pattern of antibiotic use in Hawassa University Referral Hospital, Pediatric ward, Southern Ethiopia. *Journal of Applied Pharmaceutical Science*, 2013, 3(2), 93–98. <http://dx.doi.org/10.7324/JAPS.2013.30216>

[20] JARUSEVICIENE L., RADZEVICIENE-JURGUTE R., LAZARUS J. V., JURGUTIS A., OVHED I., STRANDBERG E. L., and BJERRUM L. A study of antibiotic prescribing: the experience of Lithuanian and Russian GPs. *Central European Journal of Medicine*, 2012, 7(6), 790–799. <http://dx.doi.org/10.2478/s11536-012-0062-4>

[21] SVIESTINA I., ASTON J., and MOZGIS D. Comparison of antimicrobial prescribing between two specialist paediatric centres in the UK and Latvia. *European Journal of Hospital Pharmacy*, 2013, 20, 180–184. <https://ejhp.bmj.com/content/20/3/180>

[22] ANYANWU N., & ARIGBE-OSULA M. Pattern of antibiotic use in a tertiary hospital in Nigeria. *European Journal of Hospital Pharmacy*, 2012, 19(2), 195. <http://dx.doi.org/10.1136/ejpharm-2012-000074.291>

[23] ACHALU T. S., YIMAM B., and KEBEDE K. M. Antibiotic utilization pattern in pediatrics ward: the case from Tertiary Teaching Hospital, South West Ethiopia. *International Journal Advanced Multidisciplinary Research*, 2015, 2(9), 54–61. <https://ijarm.com/pdfcopy/sept2015/ijarm8.pdf>

[24] SAWALHA A., AL-BISHTAWI G., AL-KHAYYAT L., SWEILEH W. M., AL RAMAHI R. J., and JARADAT N. A. Pattern of parenteral antimicrobial prescription among pediatric patients in Al-Watani Governmental Hospital Palestine. *Annals of Alquds Medicine*, 2005; 1(1), 40–47. <https://pesquisa.bvsalud.org/portal/resource/pt/emr-69601>

[25] ATIF M., AZEEM M., SARWAR MR., SHAHID S., JAVAID S., IKRAM H., BAIG U., and SCAHILL S. WHO/INRUD prescribing indicators and prescribing trends

of antibiotics in the Accident and Emergency Department of Bahawal Victoria Hospital, Pakistan. *SpringerPlus*, 2016, 5, 1928.

<https://springerplus.springeropen.com/articles/10.1186/s40064-016-3615-1>

[26] MEZGEBE H.B., TADESSE B., and LEGESSE B. Antibiotic prescribing pattern in pediatric unit of Ayder Referral Hospital, Tigray region, Northern Ethiopia. *Journal of Scientific and Innovative Research*, 2015, 4(2), 57–60. http://www.jsirjournal.com/Vol4_Issue2_02.pdf

[27] PRABAHAR K., DINESH S., BARIA S., and PADMASANI L. N. Antibiotic utilization pattern in Pediatrics in a Tertiary Care Teaching Hospital. *Asian Journal of Pharmaceutics*, 2017, 11(1), 230–234. https://www.researchgate.net/publication/316153889_Antibiotics_utilization_pattern_in_pediatrics_in_a_tertiary_care_teaching_hospital

[28] CASEY J. R., & PICHICHERO M. E. Meta-analysis of Cephalosporin versus penicillin treatment of group A Streptococcal tonsillopharyngitis in children. *Clinical Infectious Disease*, 2004, 3(11), 1526–1534. <https://doi.org/10.1542/peds.113.4.866>

[29] SHIVALEELA D., JAGADEESH D. K., VEDAVATHI D., CHIDANAND D., and JEAN L. M. A study of prescription pattern of antibiotics in pediatric in-patients of McGann teaching hospital Shivamogga institute of medical sciences (SIMS), Shivamogga, Karnataka. *The International Organization of Scientific Research Journal of Dental and Medical Sciences*, 2014, 13(12), 67–71. <https://www.iosrjournals.org/iosr-jdms/papers/Vol13-issue12/Version-4/P0131246771.pdf>

参考文献:

[1] MALPANI A. K., WAGGI M., RAJBHANDARI A., KUMAR G. A., NIKITHA R., 和 CHAKRAVARTHY A. K. 三级医疗教学与非教学医院儿科门诊抗生素处方模式研究. *印度药理学实践杂志*, 2016, 9(4), 253. <https://doi.org/10.5530/ijopp.9.4.7>

[2] MISHRA H., MISHRA R., 和 MONDAL A. 印度北部一家三级护理教学医院儿科门诊抗菌药物处方模式. *国际期刊基础与临床药理学*, 2014, 3(2), 385–388. <https://www.ijbcp.com/index.php/ijbcp/article/view/441>

[3] FELEKE, M., YENET W., 和 LENJISA J. L. 埃塞俄比亚东部 比绍夫 医院儿科病房的抗生素处方模式. *国际期刊基础与临床药理学*, 2013, 2(6), 718–722. <http://dx.doi.org/10.5455/2319-2003.ijbcp20131209>

[4] STEINBERG I. 小儿传染病. 在: KODA-KIMBLE M. A., YOUNG L. Y., (编辑) 应用疗法: 药物的临床使用. 第9版. 威科费城, 2009, 1–19.

[5] KLEIN E. Y., VAN BOECKEL T. P., MARTINEZ E. M., PANT S., GANDRA S., 和 LEVIN S. A. 赫尔曼·古森斯和拉马南·拉克斯米纳拉扬. 2000 年至 2015 年间抗生素消耗的 全球增长和地域趋同. *美国国家科学院院刊*, 2018, 115(15), E3463–E3470. <https://doi.org/10.1073/pnas.1717295115>

[6] HARRISON R. F., 和 OUYANG H. 发热与急诊科抗菌药物的合理使用. *急诊医学诊所*, 2013, 31(4), 945–968. <https://doi.org/10.1016/j.emc.2013.07.007>

[7] BABY B., DAS S., HAQUE I., 和 SHERIEF H. 三级医院儿科门诊呼吸道感染抗生素处方模式的前瞻性观察研

- 究。国际药物科学评论与研究杂志, 2019, 59(1), 30-33. https://www.researchgate.net/publication/337414001_A_Study_on_Prescribing_Pattern_of_Antibiotics_for_Respiratory_Tract_Infection_in_Pediatric_Outpatient_in_A_Tertiary_Care_Hospital_A_Pro prospective_Observational_Study
- [8] MURAKI Y., YAGI T., TSUJI Y., NISHIMURA N., TANABE M., NIWA T., WATANABE T., FUJIMOTO S., TAKAYAMA K., MURAKAMI N., 和 OKUDA M. 日本抗菌素消费监测: 关于日本口服和非肠道抗菌素消费的第一份报告(2009-2013 年)。全球抗菌素耐药性杂志, 2016, 7, 19-23. <http://dx.doi.org/10.1016/j.jgar.2016.07.002>
- [9] WORLD HEALTH ORGANIZATION. 抗菌素耐药性: 全球监测报告, 2014. <https://apps.who.int/iris/handle/10665/112642>
- [10] TIPATHI K. D. 医学药理学要领。第 7 版。捷波兄弟医学出版社, 新德里, 2013, 688-700.
- [11] DESALEGN A. A. 在埃塞俄比亚南部的哈瓦萨大学教学和转诊医院使用世卫组织处方指标评估药物使用模式: 一项横断面研究。生物医学中心 健康服务研究, 2013, 13, 170. <https://doi.org/10.1186/1472-6963-13-170>
- [12] LI Y., XU J., WANG F., WANG B., LIU L., HOU W., FAN H., TONG Y., ZHANG J., 和 LU Z. 在经济刺激的推动下, 中国的过度处方导致抗生素、注射剂和皮质类固醇的大量使用。卫生事务(米尔伍德), 2012, 31(5), 1075-82. <https://doi.org/10.1377/hlthaff.2010.0965>
- [13] FATIMA R., BAIG M. T., ARSALAN A., SHAHID U., JABEEN A., ALI M. M., SHAHNAZ S., SHAIKH, S., MIRZA A. S., 和 KHAN S.A. 巴基斯坦卡拉奇三级护理医院不合理使用喹诺酮类药物。国际医学研究与健康科学杂志, 2020, 9(8), 9-12. <https://www.ijmrhs.com/medical-research/irrational-use-of-quinolones-in-tertiary-care-hospital-karachi-pakistan.pdf>
- [14] CHOUDHURY C. K., 和 BEZBARUAH B. K. 古瓦哈提医学院和医院儿科住院部抗生素处方模式。应用药理学杂志, 2013, 3(8), 144-148. <http://dx.doi.org/10.7324/JAPS.2013.3825>
- [15] THAPLIYA K., SHRESTHA S., SHEELA B., DAMODAR B., 和 CHAUDHARY R. K. 尼泊尔奇旺区儿科医院抗生素处方模式。世界药理学杂志, 2015, 4, 1641-1641. <https://www.imedpub.com/articles/prescribing-pattern-of-antibiotics-in-pediatric-hospital-in-nepal.pdf>
- [16] KHALED M. A., 和 ANSARI A. 沙特阿拉伯王国吉赞地区儿科患者的抗生素处方模式。拉吉夫·甘地 健康科学大学 药理学杂志, 2014, 4(3), 106-119. <http://dx.doi.org/10.5530/rjps.2014.3.6>
- [17] GIRMA S., SISAY M., MENGISTU G., AMARE F., 和 EDESSA D. 埃塞俄比亚东部三级护理医院儿科患者的抗菌药物使用模式: 抗菌药物管理的必要性。医院药理学杂志, 2017, 53(1), 44-54. <http://dx.doi.org/10.1177/0018578717737429>
- [18] SHAMSHY K., BEGUM I. M., 和 PERUMAL P. 印度泰米尔纳德邦埃罗德(侵蚀)一家三级医院儿科人群中抗菌药物的药物使用情况。国际医药科技研究杂志, 2011, 3, 1530-1536. <https://www.semanticscholar.org/paper/Drug-Utilization-of-Antimicrobial-drug-in-in-a-care-Shamshy-Perumal/394d878b2b7d5246a6de552a92b7733f6d37c6>
- [19] WOLDU M. A., SULEMAN S., WORKNEH N., 和 BERHANE H. 埃塞俄比亚南部儿科病房哈瓦萨大学转诊医院抗生素使用模式的回顾性研究。应用药理学杂志, 2013, 3(2), 93-98. <http://dx.doi.org/10.7324/JAPS.2013.30216>
- [20] JARUSEVICIENE L., RADZEVICIENE-JURGUTE R., LAZARUS J. V., JURGUTIS A., OVHED I., STRANDBERG E. L., 和 BJERRUM L. 抗生素处方研究: 立陶宛和俄罗斯全科医生的经验。中欧医学杂志, 2012, 7(6), 790-799. <http://dx.doi.org/10.2478/s11536-012-0062-4>
- [21] SVIESTINA I., ASTON J., 和 MOZGIS D. 英国和拉脱维亚两个专科儿科中心的抗菌药物处方比较。欧洲医院药理学杂志, 2013, 20, 180-184. <https://ejhp.bmj.com/content/20/3/180>
- [22] ANYANWU N., 和 ARIGBE-OSULA M. 尼日利亚一家三级医院的抗生素使用模式。欧洲医院药理学杂志, 2012, 19(2), 195. <http://dx.doi.org/10.1136/ejpharm-2012-000074.291>
- [23] ACHALU T. S., YIMAM B., 和 KEBEDE K. M. 儿科病房的抗生素使用模式: 埃塞俄比亚西南三级教学医院的案例。国际期刊高级多学科研究, 2015, 2(9), 54-61. <https://ijarm.com/pdfcopy/sept2015/ijarm8.pdf>
- [24] SAWALHA A., AL-BISHTAWI G., AL-KHAYYAT L., SWEILEH W. M., AL RAMAHI R. J., 和 JARADAT N. A. 巴勒斯坦 瓦塔尼政府医院儿科患者的肠外抗菌药物处方模式。圣城医学年鉴, 2005; 1(1), 40-47. <https://pesquisa.bvsalud.org/portal/resource/pt/emr-69601>
- [25] ATIF M., AZEEM M., SARWAR MR, SHAHID S., JAVAID S., IKRAM H., BAIG U., 和 SCAHILL S. 世界卫生组织/巴基斯坦巴哈瓦尔维多利亚医院急症室抗生素处方指标和处方趋势国际网络。施普林格加, 2016, 5, 1928. <https://springerplus.springeropen.com/articles/10.1186/s40064-016-3615-1>
- [26] MEZGEBE H.B., TADESSE B., 和 LEGESSE B. 埃塞俄比亚北部提格雷地区艾德转诊医院儿科的抗生素处方模式。科学与创新研究杂志, 2015, 4(2), 57-60. http://www.jsirjournal.com/Vol4_Issue2_02.pdf
- [27] PRABAHAR K., DINESH S., BARIA S., 和 PADMASANI L. N. 三级护理教学医院儿科抗生素使用模式。亚洲药剂学杂志, 2017, 11(1), 230-234. https://www.researchgate.net/publication/316153889_Antibiotics_utilization_pattern_in_pediatrics_in_a_tertiary_care_teaching_hospital
- [28] CASEY J. R., 和 PICHICHERO M. E. 头孢菌素与青霉素治疗儿童A组链球菌扁桃体咽炎的元分析。临床传染病, 2004, 3(11), 1526-1534. <https://doi.org/10.1542/peds.113.4.866>
- [29] SHIVALEELA D., JAGADEESH D. K., VEDAVATHI D., CHIDANAND D., 和 JEAN L. M. 卡纳塔克邦希瓦莫加麦甘教学医院希瓦莫加医学科学研究所儿科住院患者抗生素处方模式研究。国际科学研究组织牙科和医学科学杂志, 2014, 13(12), 67-71. <https://www.iosrjournals.org/iosr-jdms/papers/Vol13-issue12/Version-4/P0131246771.pdf>