

Original Article

Surveillance of Antibiotic Consumption Point Prevalence Survey 2014: Antimicrobial Prescribing in Pediatrics Wards of 16 Iranian Hospitals

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Abstract

Background: Antibiotics are among the most commonly prescribed drugs in pediatrics. Due to lack of uniformity in pediatric antimicrobial prescribing and the emergence of antibiotic resistance, appropriate drug utilization studies have been found to be crucial to evaluate whether these drugs are properly used.

Methods: Data were collected between January 2014 and February 2014 in 16 Iranian pediatric hospitals using a standardized method. The point prevalence survey included all inpatient beds.

Results: Of 858 children, 571 (66.6%) received one or more antimicrobials. The indications were therapeutic in 60.6%. The parenteral route was used in 92.5% of therapeutic indications. Ceftriaxone was the most prescribed antimicrobials for therapeutic indications (32.4%) and combination-therapy was the most type of therapy in pediatric intelligent care unit (PICU).

Conclusion: According to results of this study, antibiotics' prescribing in pediatrics wards of Iranian hospitals is empirical. Therefore, for quality improvement of antimicrobial use in children continuous audit process and antibiotic prescriptions require further investigation.

Keywords: Antibiotic, empiric therapy, point prevalence, prophylaxis, targeted therapy

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Introduction

Children are among the most vulnerable population groups that contract illnesses. The use of antimicrobial agents has become a routine practice for treatment of pediatric ill-

nesses, and antibiotics are among the most commonly prescribed drugs in pediatrics.¹ The link between antimicrobial use and the emergence of bacterial resistance has been clearly established and represents a major public health problem.^{2,3} The emergence of antibiotic resistance leads to increases in length of stay, mortality and, subsequently, the cost of healthcare.⁴ The investigation of antimicrobial use in children is crucial because they are an excellent environment for the selection of resistant bacterial pathogens after recent antimicrobial use.⁵ The study on prescribing practice of antibiotic has already been carried out in different population. Therefore, the aim of an antibiotic policy is to offer guidelines for the rational use of antimicrobial agents in an attempt to prevent or delay the emergence of resistant microorganism.⁶ A prevalence survey is a count of the number of patients with a particular condition/treatment at a particular time, as a proportion of the total number of patients who are hospitalized at that particular time. Point-prevalence surveys have been used to provide information about antimicrobial use and to assess the impact of interventions such as antibiotic policies.^{7,8} During the last decades, antibiotic resistance is on the rise mainly due to the abuse of broad spectrum antibiotics in first line treatment or erroneous use, and use of multiple courses or prolonged duration of treatment.⁹ So, appropriate drug utilization studies have been found to be crucial to evaluate whether drugs are properly used and utilized in terms of medical, social and economic aspects. In this study, several targets for quality improvement were identified. For example, parenteral antimicrobial administration, especially for therapeutic indications, is important since this is associated with vascular line infections,

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inconvenience to patients, prolonged hospital stay and increased costs. Another example is comparison of monotherapy and combination therapy. Several reasons could be advanced to justify the use of antimicrobial combinations, including: prevention of emergence of resistant organisms, polymicrobial infections, initial therapy; and synergism. Therefore, the objectives of this study were: 1) to describe antimicrobial prescribing in 2014 at 16 Iranian pediatrics hospitals; 2) to assess the most frequent prescribed antibiotics, the route of administration and compare the monotherapy with combination therapy in children; as well as 3) to compare antibiotic consumption between different wards such as PICU, surgery and internal medicines.

Materials and Methods

Data were extracted during one calendar week between January 2014 and February 2014 in 16 Iranian pediatrics hospitals using a web based ARPEC-webPPS protocol (Available from: URL: http://app.esac.ua.ac.be/arpec_webpps/).¹⁰ In this study, analyses were restricted to hospitals with pediatric units. Hospitals were asked to identify survey staff familiar with reading patient notes. Hospitals could decide to have the survey completed by a single person or by a team of people with specialist expertise in pediatrics or infectious diseases. Medical records of pediatric in-patients of age fall between 1 month to 15 years were reviewed prospectively. According to data collection method of Amadeo, et al.¹¹ in 2010, children who were present in the hospital at least 24 h before the survey and also present at 8 A.M. on the day of the survey (during a defined one calendar week mentioned above) were included in the survey. The following information was collected for children who were receiving antimicrobials on the day of the survey: age, antibiotic agent and its indication, route of administration, therapeutic or prophylactic use of antibiotics. Patients who had received more than one antimicrobial were considered as being on combination therapy. All outpatient children, children over age 15, and all children admitted in the psychology ward of pediatric hospital were excluded from this study. For surgical patients, administration of prophylactic antimicrobials was recorded in the previous 24 hours in order to code the duration of prophylaxis as either one dose, multiple doses given on one day or > 1 day.

We used the WHO's Anatomical Therapeutic Chemical Classification of medicines. Antibacterials are either presented by a group or by individual chemical substance (eg. cefazolin). Where necessary, the route of administration has been specified. Drug data and patient characteristic data were computed using Microsoft Excel and SPSS statistical package. The results were expressed as proportions or as means \pm standard deviation (SD).

Statistical analysis

The collected data were checked for completeness, analyzed and presented using tables and figures. Computer software called SPSS version 16 was used for analysis. Paired sample *t*-test and independent sample *t*-test were used where appropriate. A difference was considered as significant if a *P*-value was less than 0.05.

Results

A total of 858 admitted patients medical records were observed and analyzed for the evaluation antibiotic use in 16 Iranian pe-

diatric hospitals. Of 858 eligible children, 571 (66.6%) received one or more antimicrobial(s). The proportion of patients receiving antibacterial ranged from 32.9% to 100% and with the average of 64% antibiotic was prescribed for children who were admitted in hospitals. The median age in this study was 4.5 ± 1.1 years ($Q1 = 2.7$ and $Q3 = 7.2$; Interquartile range (IQR) = 4.5). The results of our study showed that 46% of all admitted patients have no underlying diseases but 9% had surgical or malformation problems followed by 8% oncologic disorders.

This study explored that among the most commonly prescribed antibiotics in our pediatric hospital (Figure 2), ceftriaxone accounted for 32.4%, followed by vancomycin 12.7% but the frequency of antibiotic prescription is different in PICU, surgery and internal diseases wards. Vancomycin (18.8%) in PICU, metronidazole (23.9%) in surgery ward and ceftriaxone (36.6%) in the internal disease ward are the most frequent antibiotics used in the pediatrics hospitals (Figure 3). Probable bacterial infection was the most common cause of antibacterial prescription in the PICU and internal diseases ward but it was different for surgery ward which surgical prophylaxis was the most important cause of antibacterial use (Figure 4 and 5).

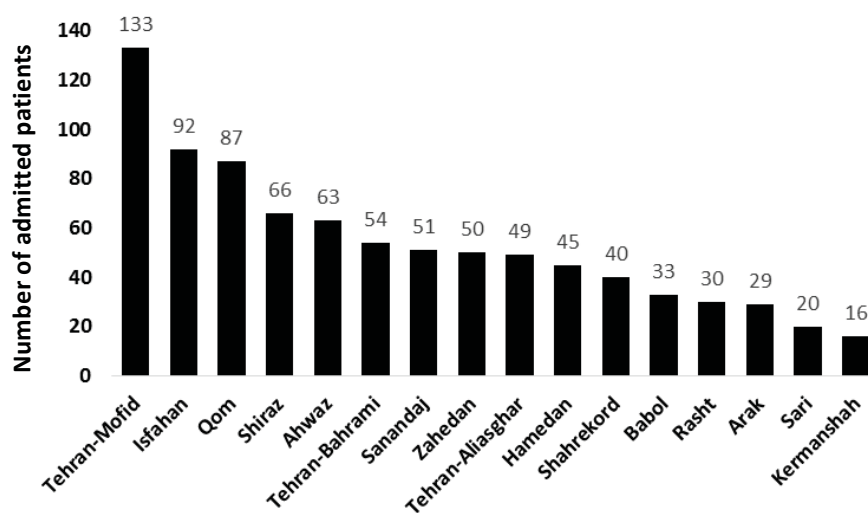
The pattern of antimicrobial use varied between surgical, medical prophylaxis, and treatment of acquired infection from society and hospitals. Of 571 antimicrobial prescriptions, 388 (68%) were prescribed for infection acquired from society, 30 (5.3%) for infection acquired during hospitalization, 60 (10.5%) for surgical prophylaxis, and 93 (16.2%) for medical prophylaxis. For surgical prophylaxis, treatment was based on single dose of antibiotic, multi-dose in one day or prolonged for >1 day. For surgical prophylaxis, the duration was more than one day in 82.2% of children at the same time as single doses and multi-doses in one day were used in 15.5% and 2.3%, respectively. The parenteral route was more commonly used than the oral route for prophylactic antimicrobials. Accordingly, in this study out of 571 medications prescribed, parenteral route was accounted for 542 (94.9 %) and oral route was only 5.1% ($P < 0.05$). Same results were obtained with comparison of PICU, surgical and internal medicine wards for route of antibiotic administration (Table 1).

Due to using antibiotic therapy in two basic ways- empiric therapy or targeted therapy- our study compared these two distinct ways. Out of 571 admitted patients, 544 (95.2%) received initial empirical antibiotic treatment (Table 1). Results showed that in our hospitals the selection of treatment was based on clinical and laboratory information with the exception of culture and sensitivity information.

Admitted children in pediatrics hospitals were treated by a single type of antibiotic (monotherapy) or combination of two or more antibacterial agents. Our results showed that combination therapy is more common (74.2%) in PICU compared to using monotherapy (25.8%) ($P = 0.02$), but the results were not the same in other pediatrics wards like surgery or internal diseases wards ($P = 0.7$). In other parts of pediatrics wards, monotherapy (56%) was preferred to combination therapy (44%).

Discussion

Approximately, 66.6% of pediatric patients in sixteen pediatrics hospitals in different cities of Iran were on antimicrobials, with considerable differences between hospitals. These variations could be explained by characteristics of hospital care systems



Pediatric units in different Iranian hospitals

Figure 1. Number of admitted patients in different pediatric units of Iranian hospitals.

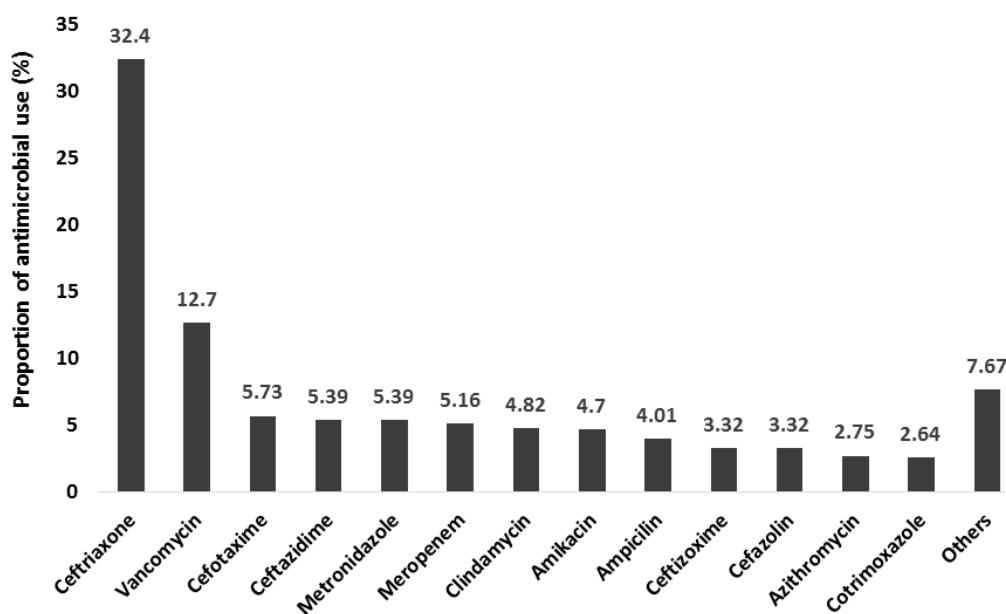


Figure 2. Administration frequency of different types of antibiotics in 16 Iranian pediatric hospitals

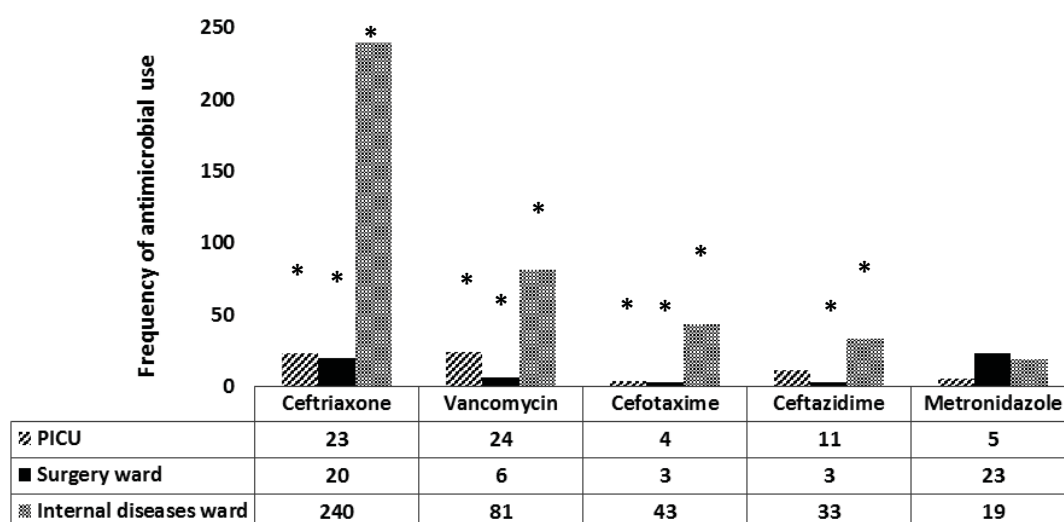


Figure 3. The frequency of antibiotic usage in PICU, surgery ward and internal diseases ward of 16 Iranian hospitals

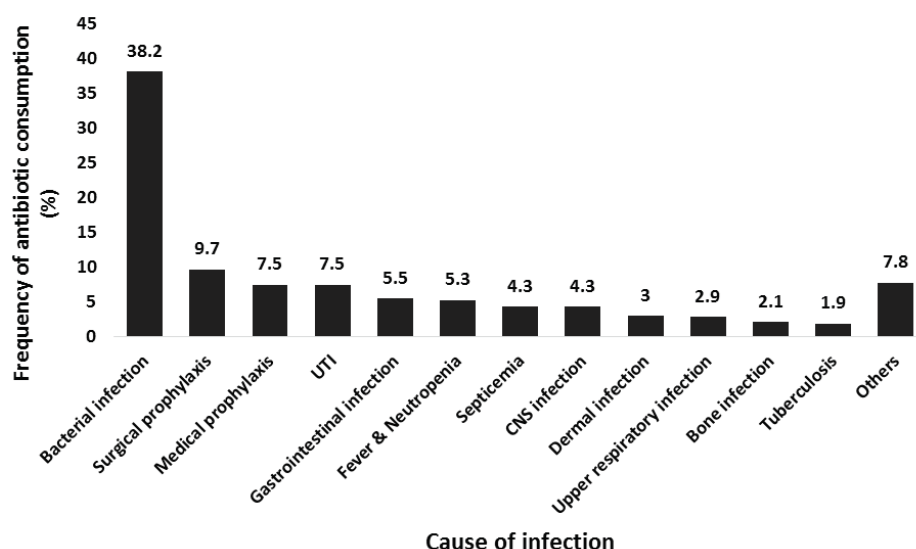
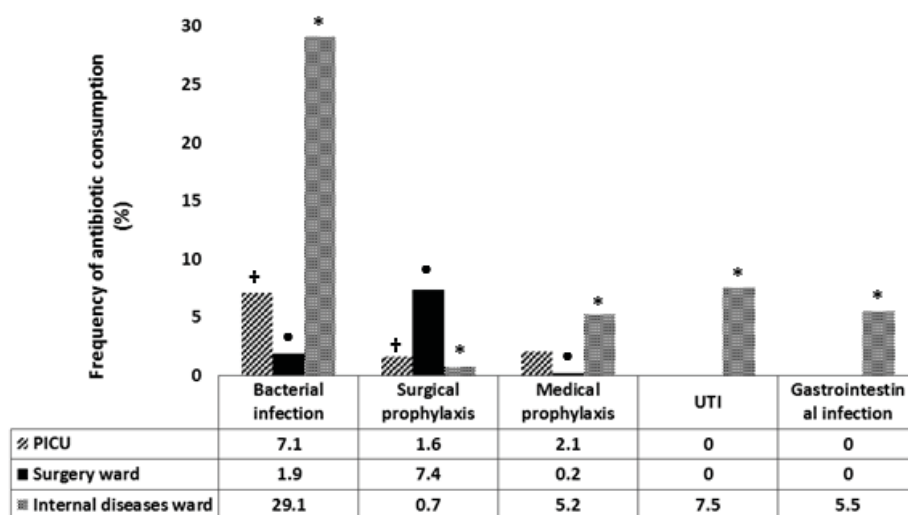


Figure 4. Frequency of antibiotic consumption according to the cause of infection in pediatric patients



* Significant differences in internal diseases ward ($P < 0.05$)

† Significant differences in PICU ward ($P < 0.05$)

• Significant differences in surgery ward ($P < 0.05$)

Figure 5. Frequency of underlying diseases in PICU, surgery ward and internal diseases ward of 16 Iranian hospitals

Table 1. Characteristics of pediatric patients receiving antimicrobials in 16 Iranian hospitals

	PICU, n (%)	Surgery ward, n (%)	Internal diseases ward, n (%)	Total (N = 571), n (%)
Acquired infection from society	49 (12.6%)	11 (2.8%)	328 (84.5%)	388 (67.9%)
Acquired infection from hospital	11 (36.7%)	2 (6.7%)	17 (56.6%)	30 (5.2%)
Surgical prophylaxis				
Single dose	0	9 (15 %)	0	9 (1.6%)
Multi-dose in one day	0	1 (1.6%)	0	1 (0.17%)
More than one day	7 (11.6%)	38 (63.3%)	5 (8.3%)	50 (8.7%)
Medical prophylaxis	18 (19.4%)	4 (4.3%)	71 (76.3%)	93 (16.3%)
Route of administration				
Parenteral	81 (94.2%)	62 (95.4%)	399 (95%)	542 (94.9%)
Oral	5 (5.8%)	3 (4.6%)	21 (5%)	29 (5.1%)
Antibiotic prescription				
Empiric	79 (91.9%)	64 (98.5%)	401 (95.5%)	544 (95.3%)
Targeted	7 (8.1%)	1 (1.5%)	19 (4.5%)	27 (4.7%)

and the case mix. This value for antimicrobial usage is about two times more than other reports in European studies.^{11–13} However, the frequency of antibiotic usage is similar to those reported from developing countries, such as 77.8% in China and 65.0% in Costa Rica.^{14,15} The pattern of antimicrobial use varied between surgical and medical prophylaxis. Our study showed that among 153 patients received antibiotic as medical and surgery prophylaxis, 93 (60.7%) were prescribed for medical prophylaxis, and 60 (39.3%) for surgical prophylaxis. Same results were obtained in Amadeo, et al. study¹¹ for European surveillance of antibiotic consumption point prevalence survey 2008. Amadeo, et al. reported that among all children admitted in hospital, 66% were prescribed for medical prophylaxis and 34% for surgical prophylaxis. For surgical prophylaxis, the duration was more than one day in 82.2% of children, 0.2% as multiple doses in one day, and single doses were used in 15.5%. Results in Amadeo, et al. study was 67% for more than one day and 8% for single dose. In this study, we showed that Ceftriaxone was the most frequently prescribed antibiotic and vancomycin the second most commonly prescribed antibiotic. Many studies reported the same results that cephalosporins were the top most used class of antibiotics in this study followed by penicillin. Among cephalosporins, the third generation of ceftriaxone and cefotaxime were found to be mostly used.^{13,16–18}

In this study, parenteral route was the most common route of antibiotic administration that accounted for 94.9%. However, oral route of antibiotic administration accounted for 5.1%. Many factors partially explain this high rate of parenteral use. This is because the largest percentages of the prescriptions in our study were made up of ceftriaxone and vancomycin, both of which are available as parenteral route only. Life-threatening infections like systemic infections and CNS infections requiring intravenous therapy and finally, younger infants are unable to take oral medications. Other studies in Europe and Africa also support our results for parenteral route of administration.^{11,19}

Antibiotic prescribing in our sixteen pediatrics hospital was almost empirical (95.2%) whereas targeted prescription was only 4.8%. Therefore, physicians must have a clear understanding of therapeutic use of antibiotics; they must be aware of the prevalence of various pathogens and resistance patterns in their hospital and exercise good judgment in selecting empirical antibiotic regimens. The high rate of empirical therapy is possibly related to low positive results of microbiological tests, which especially for culture constitutes a vicious circle, as higher and previous antimicrobial use will affect the sensitivity of these tests.

In our study, monotherapy was the most type of therapy in internal diseases and surgery ward (56%), but combination therapy was the most type of therapy in PICU (74.2%). There is clear evidence to prefer monotherapy in some cases because of drug interactions, increased cost and adverse effects of combination therapy. But in PICU ward the high proportion of combination therapy may be related to the empirical treatment without the support of microbiological test results. One study in Turkey showed that only 21.5% of pediatric patients were receiving one antimicrobial, whereas combination therapy was given to 33% of the patients.¹⁷ Their results were comparable to the results of a study in adults in Turkey and the general literature.²⁰

In conclusion, there is a need for microbiological support for clinicians to increase the appropriate prescription rate. Increasing the number of pediatric infectious disease specialists, practical antimicrobial treatment guidelines, as well as continuing educa-

tion for general pediatricians, oncologists, and surgeons are important to resolve the problem of inappropriate antimicrobial use. As antibiotics' prescribing in our hospitals is empirical, we would like to recommend that antibiotic selection should be based on culture and sensitivity test results. Lastly, we recommend further and larger scope prospective study as this is an important issue to emphasize on to ensure rational use of antibiotics and hence fighting against the alarmingly increasing antimicrobial resistance.

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Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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