



(RESEARCH ARTICLE)



## A retrospective study on the rate of prescription and resistance to cephalosporin in a hospital in Ado-ekiti, Nigeria

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### Abstract

The rate of prescription of cephalosporins especially the second and third generation and the spread of resistance among members of *Enterobacteriaceae* has become a reason for concern. This study was designed to determine the rate of prescription and resistance to the 2<sup>nd</sup> and 3<sup>rd</sup>-generation cephalosporins to *Enterobacteriaceae* in the Ekiti State University Teaching Hospital, Ado Ekiti. A retrospective study of prescription forms and laboratory reports were used in collecting the data. A total of 9,234 prescriptions issued within May 2017 to May 2018 were collected. Five thousand five hundred and twenty one (59.8%) prescriptions sheets contain at least one antibiotic. Three thousand seven hundred and thirteen prescriptions 3,713 (40.2%) did not contain any antibiotics. It was observed that Cephalosporins were the most commonly prescribed, while tetracycline was the least with 1584(28.7%) and 1076(19.5%) respectively. Cefuroxime had the highest rate of prescription with 898(57.9%) while cefpodoxime was the least prescribed with 33(2.1%). Out of the 201 diagnosed infections in patients who used cephalosporins, 83 (41.3%) were caused by members of *Enterobacteriaceae*. *E.coli* was the most common cause of infections of all the members of *Enterobacteriaceae* with 32.5%. Of all the members of *Enterobacteriaceae*, 64.2% were resistant to cephalosporin. *E.coli* had the highest resistance to cephalosporins while *Salmonella sp* had the lowest resistance with 34(22.5%) and 13(8.6%) respectively. The data obtained from this study showed that there is a significant difference between the rate of prescription of cephalosporins and other antibiotics. Also there was an excessive prescription of the second and third generation cephalosporins. In conclusion the rate of prescription of cephalosporin should be properly checked and laboratory investigations should be properly conducted before administration.

**Keywords:** Prescription; Cephalosporin; Antibiotics; Resistance Ekiti State

### 1. Introduction

Cephalosporins are among the commonly used class of antibiotics in hospitals and healthcare facilities world-wide and the use of newer generation of Cephalosporins have increased in the developing countries with limited number of studies investigating the drug prescribing and utilization pattern in the hospital setting. Increasing resistance to cephalosporins especially among second and third generation has become a cause for concern especially among *Enterobacteriaceae* [1]. *Enterobacteriaceae* are a major cause of infections in hospitalised patients [2]. These organisms can spread rapidly among patients, mostly via the hands of hospital personnel, causing nosocomial outbreaks [3]. Extended-spectrum cephalosporins such as those of third-generation (e.g. ceftriaxone, cefotaxime, ceftazidime) and fourth-generation (e.g. cefepime), are frequently used antibiotics for the treatment of severe infections, because of their ample spectrum, strong bactericidal activity, and low toxicity. However, during the past three decades, increasing number of Cephalosporin resistant Gram-negative pathogens have been reported worldwide [4]. Since their first

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description in 1983, ESBLs have been recognised as the most prevalent mechanism responsible for resistance to Cephalosporins in *Enterobacteriaceae* [5]. The increasing frequency and the rapid spread of multidrug resistance among the *Enterobacteriaceae* is a true and complex public health problem [6]. This is because the increase in the resistant has typified great concern in the effective management and treatment of infections in hospital. Therefore, there is a need to determine the rate of prescription and resistant to cephalosporins in Ekiti State.

## 2. Materials and methods

### 2.1. Study design

This research method is a retrospective survey of prescription sheets and antibiotics susceptibility of cephalosporins.

### 2.2. Study site

This study was carried out in the pharmacy of the out patients department, Maternity and Paediatrics department of the Ekiti State University Teaching Hospital (EKSUTH) Ado Ekiti.

### 2.3. Sampling techniques

Prescription sheets containing cephalosporins were collected from the three clinics with no exclusion criteria. The prescription sheets were carefully analysed for the demographic data of the patients, Class of antibiotics prescribed by the physician, Prescription rate of second and third generation cephalosporins, the results of laboratory investigation carried out within the specified time.

## 3. Results

A total of 9,234 prescriptions that were used from May 2017 to May 2018 were examined. Five thousand five hundred and twenty one (59.8%) prescriptions sheets contain at least one antibiotic. Three thousand seven hundred and thirteen prescriptions did not contain any antibiotics 3,713 (40.2%) as shown in table 1. It was observed that Cephalosporins were the most commonly prescribed with 1584(28.7%), followed by penicillins 1076(19.5%), then fluoroquinolones 947(17.2%) while tetracycline were the least prescribed with 149(2.7%) as shown in table 2. Cefuroxime was the most common of all the cephalosporins with 898 (57.9%), followed by cefixime 301 (19.0%), then ceftriaxone 129(8.1%), then cephalexin 121 (7.6%), while cefpodoxime was the least prescribed with 33(2.1%) as shown in table 3. Second generation cephalosporins was the most commonly prescribed cephalosporins with 68.9%, third generation was 31%, while first and fourth generation cephalosporins were not prescribed within the duration of this study, as shown in table4. A total of 33.8 % of the patients who used cephalosporins were male and 53.3% were female as shown in table 5. Cephalosporin prescription was common among the age group 0-10 years (31.8%) followed by the age group 31-40 years (20.1%) and 21-30 years with 18.5% prevalence rate. The age group 81-90 years had the least prescription with 4 (0.25%) as shown in table 6. Out of the 201 diagnosed infections in patients who used cephalosporins, 83 (41.3%) were caused by members of *Enterobacteriaceae*. E.coli was the most common cause of infections of all the members of *Enterobacteriaceae* with 32.5% as described in table 7. Of all the members of *Enterobacteriaceae*, 64.2% were resistant to cephalosporin. E.coli has the highest resistance to cephalosporins while *salmonella sp* had the lowest resistance with 34(22.5%) and 13(8.6%) respectively as shown in table 8

**Table 1** No of prescriptions sheets examined in Ekiti State University Teaching Hospital between May 2017 and May 2018

| Prescriptions sheets                    | No    | %    |
|---|-------|------|
| Prescriptions sheets with antibiotics   | 5,521 | 59.8 |
| Prescription sheets without antibiotics | 3,713 | 40.2 |
| Total                                   | 9,234 | 100  |

**Table 2** Rate of prescription of different antibiotics in Ekiti State University Teaching Hospital between May 2017 and May 2018

| Antibiotics      | No of Prescription | %    |
|------------------|--------------------|------|
| Cephalosporins   | 1584.67 ± 1.76     | 28.7 |
| Penicillins      | 1076.00 ± 1.15     | 19.5 |
| Fluoroquinolones | 947.00 ± 1.15      | 17.2 |
| Aminoglycosides  | 634.00 ± 1.15      | 11.5 |
| Tetracycline     | 149.00 ± 1.15      | 2.7  |
| Macrolides       | 205.00 ± 1.15      | 3.7  |
| Chloramphenicol  | 77.00 ± 1.15       | 1.4  |
| Metronidazole    | 926.00 ± 1.15      | 16.8 |

The result shows that, there was a level of significant differences ( $P \leq 0.05$ ) in all the antibiotics used when compared with cephalosporin.

**Table 3** Rate of prescription of cephalosporins in Ekiti State University Teaching Hospital between May 2017 and May 2018

| Cephalosporins | Rate          | Percentage % |
|----------------|---------------|--------------|
| Cefuroxime     | 918.00 ± 1.15 | 57.9         |
| Cefixime       | 301.00 ± 1.15 | 19.0         |
| Ceftriaxone    | 129.00 ± 1.15 | 8.1          |
| Ceftazidime    | 34.00 ± 1.15  | 2.2          |
| Cetrixime      | 48.00 ± 1.15  | 3.0          |
| Cephalexin     | 121.00 ± 1.15 | 7.6          |
| Cefpodoxime    | 33.00 ± 1.15  | 2.1          |

The result showed a level of significant differences ( $P \leq 0.05$ ) in Cefuroxime when compared with all other cephalosporins

**Table 4** Rate of prescription of different generation of cephalosporins in Ekiti State University Teaching Hospital between May 2017 and May 2018

| Cephalosporin              | No    | %    |
|----------------------------|-------|------|
| 1 <sup>st</sup> generation | -     | -    |
| 2 <sup>nd</sup> generation | 1,092 | 68.9 |
| 3 <sup>rd</sup> generation | 492   | 31.1 |
| 4 <sup>th</sup> generation | -     | -    |
| Total                      | 1584  | 100  |

**Table 5** Gender distribution of the use of cephalosporin in Ekiti State University Teaching Hospital between May 2017 and May 2018

| Sex          | No   | %    |
|--------------|------|------|
| Male         | 536  | 33.8 |
| Female       | 845  | 53.3 |
| Unidentified | 203  | 12.8 |
| Total        | 1584 | 100  |

**Table 6** Age distribution of the use of cephalosporins in Ekiti State University Teaching Hospital between May 2017 and May 2018

| Age group(years) | Total | Percent |
|------------------|-------|---------|
| 0-10             | 503   | 31.8%   |
| 11-20            | 111   | 7.0%    |
| 21-30            | 293   | 18.5%   |
| 31-40            | 318   | 20.1%   |
| 41-50            | 73    | 4.6%    |
| 51-60            | 64    | 4.0%    |
| 61-70            | 53    | 3.4%    |
| 71-80            | 19    | 1.2%    |
| 81-90            | 4     | 0.25%   |
| unidentified     | 146   | 9.2%    |
| Total            | 1584  | 100     |

**Table 7** Occurrence of Organisms Isolated from Infections in Ekiti State University Teaching Hospital between May 2017 and May 2018

| Organisms            | Occurrence | Percentage |
|----------------------|------------|------------|
| <i>E. coli</i>       | 49         | 32.5       |
| <i>Proteus</i> sp    | 32         | 21.2       |
| <i>Klebsiellasp</i>  | 25         | 16.6       |
| <i>Salmonella</i> sp | 21         | 13.9       |
| <i>Shigellasp</i>    | 25         | 16.6       |
| Total                | 152        | 100        |

**Table 8** Rate of resistance to cephalosporins among members of *enterobacteriaceae* in Ekiti State University Teaching Hospital between May 2017 and May 2018

|                          | CEF       | CFM      | CRO     | CFZ     | CET     | CPX     | CFP     | Total     |
|--------------------------|-----------|----------|---------|---------|---------|---------|---------|-----------|
| <i>E.coli</i> (n=49)     | 23(46.9%) | 6(12.2%) | 2(4.1%) | -       | 2(4.1%) | -       | 1(2.0%) | 34(69.4%) |
| <i>Proteus</i> (n=32)    | 13(40.6%) | 4(12.5%) | -       | 2(6.3%) | 1(3.1%) | -       | -       | 20(62.5%) |
| <i>Klebsiella</i> (n=25) | 11(44.0%) | 3(12.0%) | -       | 1(4.0%) | 1(4.0%) | -       | 1(4.0%) | 17(68.0%) |
| <i>Salmonella</i> (n=21) | 8(38.1%)  | 2(9.5%)  | 2(9.5%) | -       | -       | 1(4.8%) | -       | 13(61.9%) |
| <i>Shigella</i> (n=25)   | 10(40.0%) | -        | 2(8.0%) | 2(8%)   | -       | -       | -       | 14(56.0%) |
| Total (152)              | 65(42.7%) | 15(9.9%) | 6(3.9%) | 5(3.3%) | 4(2.6%) | 1(0.7%) | 2(1.3%) | 98(64.4%) |

#### 4. Discussion

Infectious diseases remain a leading cause of illness throughout the world. As revealed by this study 59.8% of the total prescriptions contained at least one antibiotic, which was used in treating infectious diseases. According to [7] the 65% of all deaths in Sub-Saharan Africa come from infectious diseases. Cephalosporins are one of the classes of antibiotics that need careful attention to ensure their rational use in this era of increased threat due to microbial resistance. However, this study revealed that this was lacking as there was excessive use of these classes of antibiotics. The rate of prescription of cephalosporin in Ekiti State University Teaching Hospital was 28.7% and this is higher than other classes of antibiotics. This result is similar to the research carried out by [8] in Bangladesh where the most commonly prescribed antibiotic groups were cephalosporins with (31.78%), also [9], in Sudan in 2010 reported that Cephalosporins constituted more than one third (34.5%) of the prescribed antibiotics and also [10], in India reported that cephalosporins were found to be the most commonly prescribed antibiotics with 41.5%. Another study conducted by [11], however reported higher prescription for penicillins (72%) than cephalosporins (28%) and other antibiotics. The rate of prescription of cefuroxime, which is a second generation cephalosporins, which is also a broad spectrum antibiotic is on a very high side according to this research with (57.9%). This is similar to the research carried out by [12] in the Swedish intensive care unit where Cefuroxime was the most commonly prescribed antibiotic before and during admission (28% and 24%) respectively. This is not surprising because it is less susceptible to beta-lactamase. Hence, it may have greater activity against gram negative organisms. Unlike most other second-generation cephalosporins, cefuroxime can cross the blood-brain barrier. In this study it was observed that the rate of prescription of cephalosporins were common among females with the rate of 53.3%, which shows that infections were more common among females than males. Rate of prescription of cephalosporin in children (less than 10 years) according to this study is at the rate of 31.8% which is higher than other age groups with. This is not surprising because of their weak immune system. Irrational use of antibiotics is a contributing factor to the development of antibiotic resistance [13]

*E.coli* was found to be the most common cause of infection among the members of *Enterobacteriaceae* with (32.5%), the present study has shown that there is probability of production of new  $\beta$ -lactamases by the *Enterobacteriaceae* isolated in this environment. This is demonstrated by the very poor susceptibility of the members of *Enterobacteriaceae* to cephalosporins by all the isolates with 64.2% resistance. This may be an indication that there is production of the new  $\beta$ -lactamases in these isolates. Such resistant isolates pose serious problems to the physicians as therapeutic options are limited. *E.coli* shows the highest rate of resistance among the members of *Enterobacteriaceae*. The increasing occurrence of cephalosporins-resistant *E. coli* isolates of human origin is a global public health problem. Cephalosporin-resistant *E. coli* infections are presently associated with higher morbidity, mortality and invariably higher expenditure in treatment.

#### 5. Conclusion

The rate of prescription of cephalosporins especially cefuroxime which was found to be excessive and they are most commonly used antibiotics in the study area. Also the rate of prescription of cephalosporins was also common among children aged 0-10 years and also common among females than males. *E.coli* was also found to be the most common cause of infection and it also had the highest resistance to the antibiotics to which they were tested. The members of *Enterobacteriaceae* showed the highest resistance to cefuroxime.

### *Recommendation*

It is necessary to maintain a healthy habit to prevent germs and infectious disease from spreading, there should be proper vaccination for children and epidemiologist should monitor endemic diseases and set up measures to prevent them. It is also important to take action to improve prescribing habits in order to reduce the unnecessary usage of antibiotics thus enhance rational antibiotic use. Access to quality laboratory services is often seen as pivotal to the correct use of antimicrobials. This will not only benefit individual patients but will also provide early warnings of the emergence of resistant isolates and surveillance data on trends.

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### **Compliance with ethical standards**

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#### *Conflicts of interest*

All authors have seen and agree with the contents of the manuscript and there is no conflict of interest.

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