

# Drug use evaluation of cephalosporins in a tertiary care hospital

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## Abstract

**Background:** Infectious disease burden in India is among the largest in the world. Cephalosporins are being used extensively in the current scenario, both empirically and as definitive treatment. With this information, we tried to evaluate the prescription pattern of drugs for infections in medicine and general surgical wards of a tertiary care hospital and evaluate the utilization of cephalosporins in the same.

**Methodology:** The study was conducted for a duration of 3 months in a tertiary care hospital after approval from the Institutional Ethics Committee, and permission of the respective heads of the surgery and medicine departments was obtained. After satisfying the inclusion criteria, participants' demographic details and the prescription notes by the treating doctor were noted and analyzed. The WHO prescription indicators were analyzed and the prescriptions were evaluated for the completeness of them. The utilization of cephalosporins was evaluated based on the institutional standard treatment guideline (STG) – Guidelines for Antimicrobial Therapy and Prophylaxis, 2014. Data were analyzed using descriptive statistics.

**Results:** A total of 600 patients were recruited, of which 350 were male and 250 were female. A total of 4341 drugs were prescribed. On an average, 7 drugs per prescription were found. The generic drugs prescribed were 27% (1163). Among the drugs prescribed, 19% (850) were antibiotics, of which 36.94% (314) were cephalosporins and 81% (3491) were other drugs. Ninety-four percent (565) prescriptions were incomplete (in terms of dose, frequency, duration, or dosage form). After referring to the STG, we found that cephalosporins were prescribed empirically in 40% (126) cases, of which medicine prescriptions accounted for it the most.

**Conclusion:** Cephalosporins are extensively prescribed in medicine and surgery wards of the tertiary care hospital.

**Keywords:** Antibiotic resistance, ceftriaxone, infection, prescription pattern

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## INTRODUCTION

Infectious disease burden in India is among the largest in the world.<sup>[1]</sup> The crude mortality rate from infectious diseases in India is 417/1 lakh persons. The scenario is

even worse in African countries and Afghanistan. The global burden of infectious diseases is on the rise.<sup>[2]</sup> With the rise in burden of infections, the use of antibiotics is also steadily increasing. A study “Global Trends in

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Antibiotic Consumption” by scientists from Princeton University has found that worldwide antibiotic use has risen a staggering 36% in a period of 10 years, which included five countries – Brazil, Russia, India, China, and South Africa – responsible for more than three-quarters of that surge. The increase in the use in India was a whopping 62%, in comparison with the global rise of 36%. Among the 16 groups of antibiotics studied, cephalosporins, broad-spectrum penicillin, and fluoroquinolones accounted for more than half of that increase.<sup>[3]</sup>

Antimicrobial resistance (AMR) is a growing problem all around the world, especially in India. The leading causes of AMR are as follows: overprescription, patients not completing their course of antibiotics, overuse in livestock and fish farming, poor infection control in health-care settings, poor hygiene and sanitation in health-care settings, and empirical use of antibiotics.<sup>[4]</sup> AMR has led to an increase in the expenditure on antibiotics. It also has led to increased death tolls and disease-related complications. Each year in the USA, at least 2 million people get infected with antibiotic-resistant bacteria and 23,000 among these die. Many more die from conditions complicated by AMR.<sup>[5]</sup>

Third-generation cephalosporins are being used extensively in the current scenario, both empirically and as a definitive treatment.<sup>[6]</sup> Empirical and prophylactic usage of drugs can lead to increased AMR, complications, and death. It will also contribute to an increase in hospital expenditure on antibiotics; therefore, it is necessary to ensure that prescription should only be made according to protocols mentioned in the standard treatment guidelines (STGs).

Drug use evaluation is a system of continuous, systematic, criteria-based drug evaluation that ensures appropriate use of drugs. Evaluation is based on criteria including indications, diagnostic criteria, choice of drug, dosing, frequency, and duration of therapy. Data were collected by reviewing prescriptions of inpatients in the hospital over a specific period of time.

With this background, we conducted a study on prescription pattern of drugs in medical and surgical wards in specific to the usage of cephalosporins in the setting of KEM Hospital, Mumbai, Maharashtra, based on STGs. The third-generation cephalosporins mainly ceftriaxone, cefotaxime, and cefoperazone are broad-spectrum antibiotics prescribed for meningitis, urinary tract infection, typhoid, spontaneous bacterial peritonitis, and leptospirosis. Interestingly, there are fewer studies on this aspect in India, particularly in the region of western India in the recent past.<sup>[7]</sup>

## Objectives

1. To evaluate the prescription pattern of drugs for infection in medicine and general surgical wards of a tertiary care hospital
2. To evaluate the utilization of cephalosporins in medicine and general surgical wards of a tertiary care hospital.

## METHODOLOGY

This was a cross-sectional, prospective, observational study for the evaluation of prescription pattern of drugs for infection and utilization of cephalosporins conducted in the inpatient wards of medicine and general surgery wards of a tertiary care hospital over a period of 3 months from July 2018 to September 2018. After permission was obtained from the Institutional Ethics Committee (EC/OA-61/2018) and heads of the concerned departments, participants of either gender and age above 18 years who were prescribed antibiotics (including penicillins and other beta-lactams, sulfonamides, cotrimoxazole and quinolones, tetracyclines and chloramphenicol, aminoglycoside, macrolides, lincosamide and glycopeptide antibiotics, anti-infective dermatological and ophthalmological drugs, and antidiarrheal drugs with streptomycin, neomycin, nifuroxazide, or combinations) in their treatment chart were screened by a member of the investigating team and then chosen as participants for the study. Participants or his/her legally acceptable representatives willing to give voluntary informed consent were included in the study. Demographic details of the participants such as registration number, age, gender, and weight were recorded. Diagnosis of the disease and medication details as listed in the case notes were recorded. The number of drugs prescribed in every prescription was taken into account.

## Variables assessed

### Prescribing indicators

According to the WHO guidelines, the prescription pattern of drugs was analyzed with respect to the following variables:

- Average number of drugs per prescription
- Percentage of drugs prescribed by generic name
- Percentage of encounters with an antibiotic prescribed
- Percentage of encounters with an injection prescribed
- Percentage of drugs prescribed from essential drug list.

Other variables assessed were as follows:

- Percentage of antibiotics prescribed
- Average number of antibiotics per prescription
- Percentage of antibiotics prescribed by generic name

- Percentage of complete/incomplete prescriptions.

The utilization of cephalosporins was evaluated based on the institutional STG – Guidelines for Antimicrobial Therapy and Prophylaxis, 2014.

### Statistical analysis

All the data variables were entered in Microsoft Excel version 2019. The data were assessed using descriptive statistics.

## RESULTS

### Demographic details

Of 600 participants enrolled during the study period, we found that there were 350 males (58.33%) and 250 females (41.67%). The mean age was 47 years, with a range of 18–95 years. Of the 600 prescriptions, 359 (59.83%) belonged to medicine and 241 (40.17%) were of surgery.

### Prescription indicators

A total number of 4341 drugs were prescribed over 600 prescriptions. Prescription indicators were analyzed according to the WHO indicators and summarized in Table 1. Among all drugs, the percentage of antibiotics prescribed was around 20% (850/4341). Moreover, on an average 1.42, the number of antibiotics was prescribed in each prescription. Among antibiotics, again, only 18% (153) of them were prescribed with generic name.

Of total 600 prescriptions, only 6% of prescriptions were found to be complete (19 prescriptions of medicine and 16 prescriptions of surgery). The rest 94% were incomplete. The incomplete domains of prescription are summarized in Figure 1.

In the medicine department, most of the antibiotics were prescribed for the indications lower respiratory tract infection (89), febrile illness - including dengue and malaria (78), acute gastritis (72) and meningitis (54). In surgery, patients with cellulitis (56) and hernia (49) were prescribed antibiotics more in number, followed by pancreatitis (48), appendicitis (44), and cholelithiasis (23).

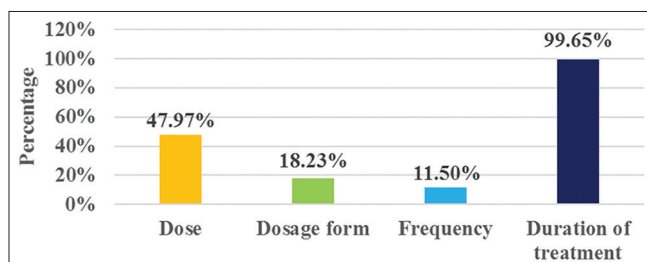


Figure 1: Various domains of incomplete prescription

Culture and sensitivity testing reports were found in only 25% prescriptions of medicine (89/359) and in around 61% prescriptions of surgery (147/241).

### Utilization of cephalosporins

Among all antibiotics prescribed, cephalosporins prescribed were around 37%. Among other antibiotics, metronidazole and fixed-dose combination (FDCs) containing amoxicillin and clavulanic acid were the next most commonly prescribed. The details are summarized in Figure 2.

We found that all the cephalosporins (314) which were prescribed were given through intravenous route only and all belonged to the third generation – in which ceftriaxone (189) was prescribed in majority of the cases, followed by cefotaxime (72) and cefixime (39). Furthermore, FDC of ceftriaxone and sulbactam was seen in 15 prescriptions.

After referring to the STGs – “Guidelines for Antimicrobial Therapy and Prophylaxis 2014,” we found that cephalosporins were prescribed empirically in 40% of the cases (126/314), of which medicine prescriptions accounted for it the most (111/126). In medicine, majority of the empirical prescriptions were seen in acute exacerbation of chronic obstructive pulmonary disease cases (56) and febrile illness (44), whereas in surgery, it was cellulitis (11), followed by pancreatitis (5).

## DISCUSSION

Our study focused on the prescription pattern of

Table 1: WHO prescription indicators

Prescription indicators	Results
Average number of drugs per encounter	7.235% (4341/600)
Percentage of drugs prescribed by generic name	26.79% (1163/4341)
Percentage of encounters with an antibiotic prescribed	100% (600/600)
Percentage of encounters with an injection prescribed	100% (600/600)
Percentage of drugs prescribed from essential drug list	71.71% (3113/4341)

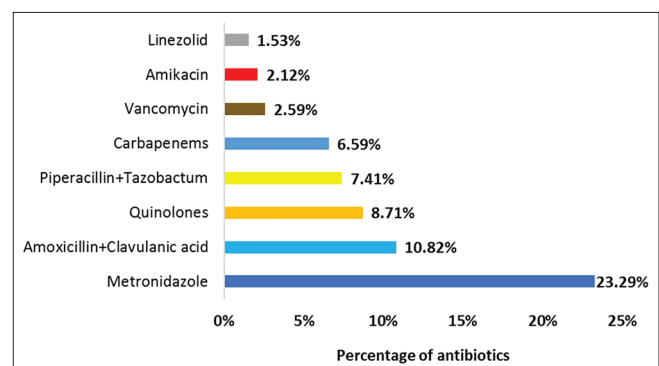


Figure 2: Percentage of other antibiotics prescribed

cephalosporins in medicine and general surgery departments of a tertiary care hospital in the region of western India. As a matter of fact, such studies are scarce in the western Indian region. Similar studies have been done in parts of South India recently.

In the present study, a total of 600 patients were recruited in the 3-month period. The sample size is in accordance with the WHO rational use of medicine guideline. Similar studies conducted in various parts of India had recruited a lesser sample size. Studies conducted by Naveen *et al.*,<sup>[6]</sup> Soman *et al.*,<sup>[7]</sup> Dahal *et al.*,<sup>[8]</sup> Gururaja,<sup>[9]</sup> Goudanavar *et al.*,<sup>[10]</sup> and Reddy *et al.*<sup>[11]</sup> had recruited 110, 250, 150, 400, 100, and 250, respectively. The average number of drugs per prescription was 7.235 in our study, whereas it was 5.8, 8.62, and 7.89 in studies conducted by Dahal *et al.*,<sup>[8]</sup> Goudanavar *et al.*,<sup>[10]</sup> and Reddy *et al.*,<sup>[11]</sup> respectively. All the prescriptions had one or more injectable as all the participants recruited were admitted either in the medicine ward or general surgery ward.

In the present study, drugs were prescribed by their generic name in only 27% of total drug prescriptions. In a similar study conducted by Kala *et al.*,<sup>[12]</sup> it was found to be 33%. There has also been reporting of only 2.43% drugs being prescribed by generic name in a study done by Goudanavar *et al.*<sup>[10]</sup> Commonly, drugs are prescribed in brand names because many of the drugs are not available in generic form. Furthermore, there is no denial about the influence from the pharmaceutical industry on the doctors to write drugs by their brand names. Such influence can also be seen with pharmacists while dispensing the medications.

Among cephalosporins, only those belonging to the third generation were prescribed in the present study. The study conducted by Reddy *et al.*<sup>[11]</sup> also reported the same trend in a similar study. This shows a general preference to third-generation cephalosporin over the older generations. This is an area of concern as first- and second-generation cephalosporins are being underutilized. This may be due to nonavailability of these drugs in the hospital formulary.

Among the third-generation cephalosporins, ceftriaxone (60.19%) was the most prescribed drug in the present study, followed by cefotaxime (22.9%) and cefixime (12.4%). Similar results were seen in the studies conducted by Dahal *et al.*,<sup>[8]</sup> Gururaja,<sup>[9]</sup> and Reddy *et al.*<sup>[11]</sup> where ceftriaxone was the most commonly prescribed cephalosporin – 68%, 69%, and 60.1%, respectively. Ceftriaxone is among the most commonly utilized antibiotics due to its high potency, a wide spectrum of activity, and a low risk of toxicity.<sup>[13]</sup> Ceftriaxone should be

reserved for terminal ill patients, so the therapy should be initiated with first- or second-generation cephalosporins, wherever indicated. When in crisis, we will not have antibiotics in hand. In the present study, metronidazole was the most common antibiotic prescribed along with cephalosporins.

Nitroimidazoles, for example, metronidazole for suspected anaerobes may have been used along with cephalosporins which may cover Gram-positive and Gram-negative bacteria including *Pseudomonas*. This is in line with the finding in the study conducted by Gururaja,<sup>[9]</sup> whereas a study by Nagaraju *et al.*<sup>[14]</sup> reported quinolones as the second most common antibiotic after cephalosporins.

In the present study, the most common infections in medicine wards for prescribing antibiotics were LRTI, followed by fever, acute gastroenteritis, and meningitis. In surgical prophylaxis, it was cellulitis, followed by hernia, pancreatitis, and appendicitis. In the study conducted by Dahal *et al.*,<sup>[8]</sup> the most common indication LRTI, followed by meningitis and gastroenteritis.

Culture and sensitivity testing reports were found in only 25% prescriptions of medicine and in around 61% prescriptions of surgery. In the study conducted by Dahal *et al.*,<sup>[8]</sup> it was found that only 12% had culture and sensitivity reports. Furthermore, in the study conducted by Gururaja,<sup>[9]</sup> it was found that 16.5% of the cases had the culture reports. Hence, in general, there is less emphasis by the clinicians to see for the culture reports and then decide on the right antibiotic to be prescribed to the patients. As the present study was conducted in a tertiary care hospital, doctors do make the empirical diagnosis of bacterial infection. To avoid prolonged illness to the patient and the fact that patients usually would have already been exposed to some kind of antibiotics before arriving to the tertiary care set up, clinicians usually prefer to use broad-spectrum antibiotics to suppress infection. In our study, around 40% of cephalosporins were prescribed empirically. Empirical treatment was practiced more commonly in medicine OPDs. Physicians might have thought that the referred patients had to be put on a broad-spectrum regimen like ceftriaxone to cover for bacteria that might have developed resistance after the previous antibiotic exposures. The trend to send a sample for culture sensitivity was found more in the surgery department. However, prescribing or changing the prescription based on culture sensitivity finding was not followed rigidly in either of the departments. Many a times, decisions are taken on clinical judgment and response rate of the patients. We cannot deny the fact that many of the patients may have responded, so there was no need to

change antibiotics based on culture and sensitivity reports. Cephalosporins' prescribing practices may be lifesaving, but a need arises wherein such prescriptions ought to be guided by locally generated data on sensitivity patterns. Antibiotic stewardship program needs to be initiated in the hospital to sensitize physicians and surgeons to use drugs emphatically and reduce resistance and save antibiotics for future use. Hospital antibiotic stewardship programs can impose and enforce prescription restrictions, set up antibiotic consumption surveillance systems, and deliver appropriate educational campaigns to prescribers.

STGs formulated in the hospital help to reduce empirical treatment and thereby helps in preventing the development of resistance to cephalosporins too. It is based on the antibiogram of the hospital.

There are few limitations in the study as the data generated can only be generalized to another tertiary care unit. We had hospital formulary, but we did not check the availability of the drugs during the time of the study and prescription accordingly. The institutional STGs were outdated as it was made in the year 2014. Hence, the practice of the physicians by taking the help of the STGs cannot be commented. Furthermore, as it was a cross-sectional study, all the other prescribing practices could not be tapped.

## CONCLUSION

The present study revealed extensive use of third-generation cephalosporins in the medical and surgical ward settings without taking in consideration culture and sensitivity report.

## Recommendations

First- and second-generation cephalosporins need to be utilized for appropriate indications and their availability in the hospital formulary needs to be ensured. Physicians should be encouraged more toward the practice of obtaining culture and sensitivity report in all possible situations and thereby enabling themselves to prescribe definitive treatment (rather than empirical) options to the patients. Antibiotic prescriptions should be made according to STGs as formulated by the institution and should be updated regularly.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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