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Original Article

Pharmacology Section

# A Retrospective Analysis Of Culture SensitivityAnd Antimicrobial Prescribing Pattern In A Teaching Hospital Of Eastern Nepal

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## ABSTRACT

**Background:** Antibiotic resistance in healthcare system is a widespread and inevitable problem which is mainly due to their inappropriate and indiscriminate prescribing or use. The misuse of antibiotics which is having substantial detrimental consequences is under the influence of clinicians' education, existing beliefs, incentives offered by the pharmaceutical manufacturers, hospital's sales profit and usual trend among the prescribers to use antimicrobials haphazardly.

**Objectives:** The objective of the study was to determine the pattern of bacterial culture sensitivity and antimicrobials prescribing.

**Material and Methods:** The study was a retrospective cross-sectional analysis of culture sensitivity reports for duration of 5 months (May to September 2010) at the laboratory of department of microbiology, Nobel Medical College and Research Centre, Biratnagar Nepal. Data was collected through a self designed and pre-piloted questionnaire. The questionnaire contained information on patient's particulars, diagnosis, specimen, culture sensitivity and antimicrobials prescribed before performing culture sensitivity tests. Patient's names and hospital Identification number were noted from the register and their respective prescriptions were investigated from medical record department of the hospital. The prescriptions were analyzed for the antimicrobials prescribed before carrying out culture sensitivity tests. The data was coded, verified, entered and analyzed using Statistical Package for Social Sciences version 11.5 Chicago, Inc.

**Results**: Majority (71%) of the patients were below the age of 30 years. Diagnosis of the disease was not mentioned in majority (88%) of the reports. *Staphylococcus aureus* and *Escherichia coli* were the most commonly occurring bacteria (78%). Treating infectious complications with single antimicrobial agent was predominant (68%). Furthermore, third generation cephalosporins (47%) particularly ceftriaxone and cefotaxime were the most commonly prescribed agents, but culture sensitivity was not performed against them. There was a striking practice of prescribing antimicrobials against the bacteria which were either resistant or culture sensitivity was not performed.

**Conclusion:** Bacterial resistance and inappropriate prescribing of antimicrobials are important issues at Nobel teaching hospital which entails expanding antimicrobial susceptibility testing to commonly used or prescribed antimicrobials.

**Key Words:** Antimicrobial, Culture sensitivity, Eastern Nepal, Prescribing pattern

## INTRODUCTION

Antibiotic resistance in healthcare system is a widespread and inevitable problem which leads to poor treatment outcome and higher costs of therapy [1, 2]. There may be various factors in the development of bacterial resistance, but inappropriate and indiscriminate prescribing or use of antibiotics contribute significantly [3-5]. On the other hand, a precise antibiotic utilization strategy in accordance with culture sensitivity test improves the rational therapy of infectious diseases and is helpful in decreasing or preventing the emergence of bacterial resistance [6-8].

In hospital settings, physician's assistants are more inclined towards prescribing antibiotics than practicing physicians [9]. Moreover, there is a usual trend among the prescribers to initiate the therapy with one category of antibiotic and keep on changing till symptoms subside [10]. The misuse of antibiotics which is having substantial detrimental consequences is under

the influence of various factors such as clinician's education, existing beliefs, incentives offered by the pharmaceutical manufacturers and hospital's sales profit [10].

The objective of the study was to determine the pattern of bacterial culture sensitivity and antimicrobials prescribing.

## MATERIALS AND METHODS

This study was a retrospective cross-sectional analysis of culture sensitivity reports for the duration of 5 months (May 2010 to September 2010) at the laboratory of department of Microbiology, Nobel Medical College and Research Centre, Biratnagar, Nepal. Initially 90 culture sensitivity reports were encountered from the microbiological culture sensitivity register, but around 15 reports were found lacking required information in accordance with the objectives of the study. Thus, only 75 reports were identified and considered for further analyses. Data was collected through a self designed and pre-piloted questionnaire. The questionnaire contained information on patient's particulars, diagnosis, specimen, culture sensitivity and antimicrobials prescribed before performing culture sensitivity tests. Patient's names and hospital ID number were noted from the register and their respective prescriptions were investigated from medical record department (MRD) of the hospital. The prescriptions were analyzed for the antimicrobials prescribed before carrying out culture sensitivity tests. The data was coded, verified, entered and analyzed using Statistical Package for Social Sciences (SPSS) version 11.5 Chicago, Inc.

## RESULTS

Gender wise, culture sensitivity was more common among male patients (61%) compared with their female counterparts (39%). Majority (71%) of the patients were below the age of 30 years. [Table/Fig-1] depicts that diagnosis of the disease was not mentioned in majority (88%) of the culture sensitivity (C/S) reports. Seven different types of bacteria were isolated from the culture and the most common bacteria were *Staphylococcus aureus* (41%) and *Escherichia coli* (37%).

A total of 21 antimicrobial agents from seven different pharmacological categories were prescribed. The most commonly prescribed agents were the third generation cephalosporins 35 (47%) followed by fluoroquinolones 17 (23%). Other agents were oral penicillins (single as well as in combination) and aminoglycosides 15 (20%) each, metronidazole 9 (12%), macrolides antibiotics 6 (8%) and nitrofurantoin 3 (4%). Ceftriaxone and cefotaxime were the extremely favoured agents from the family of cephalosporins. Similarly, ofloxacin, co-amoxi-clav, gentamicin and erythromycin were the most commonly prescribed agents from fluoroquinolones, penicillins, aminoglycosides and macrolides respectively. Most (68%) of the prescriptions contained single antimicrobial agents. However, two and three antimicrobials were evident in 28% and 4% of the prescriptions respectively.

| Variables | Characteristics | Number | Percentage |
|---|---|---|---|
| Specimen | Urine | 24 | 32.0% |
| | Blood | 20 | 26.7% |
| | Pus | 17 | 22.7% |
| | Pleural fluid | 05 | 6.7% |
| | Semen | 04 | 5.3% |
| | Knee joint aspiration fluid | 01 | 1.3% |
| | Swab | 01 | 1.3% |
| | Body fluid | 01 | 1.3% |
| | Not mentioned | 02 | 2.7% |
| Diagnosis | UTI | 01 | 1.3% |
| | Lt pyothorax | 02 | 2.7% |
| | Acute appendicitis | 03 | 4.0% |
| | Perimucosal abscess | 01 | 1.3% |
| | Wound | 01 | 1.3% |
| | Rheumatic fever | 01 | 1.3% |
| | Not mentioned | 66 | 88.0% |
| Bacteria | Staphylococcus aureus | 31 | 41.3% |
| | Escherichia coli | 28 | 37.3% |
| | Klebsiella pneumoniae | 07 | 9.3% |
| | Pseudomonas aeruginosa | 04 | 5.3% |
| | Streptococcus pneumoniae | 02 | 2.7% |
| | Citrobacter freundii | 02 | 2.7% |
| | Proteus mirabilis | 01 | 1.3% |

**[Table/Fig-1]:** Specimen, Diagnosis and Bacteria

[Table/Fig-2] shows that the two most common bacteria, i.e. *Staphylococcus Aureus* and *Escherichia coli* were the least resistant to ofloxacin and gentamicin, but highly resistant to ceftazidime and cefotaxime.

[Table/Fig-3] is concerned with the sensitivity pattern of overall bacteria against different antimicrobials. It reveals that the moderately resistant pattern of bacteria was subtle, whereas either sensitive or resistant trend was perceptible. The trend of not performing C/S was common in practice.

**Note:** AC-Coamoxiclav, Cftd-Ceftazidime, Ctxm-Cefotaxime,

| Organisms | No of specimens resistant / No of specimens tested (% resistant) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AC | Cftd | Ctxm | Co | Na | Na | Ofx | Cip | G | Amp |
| *S. aureus* | 6/17 (35) | 3/3 (100) | 1/1 (100) | 14/17 (82) | 0 | 1/1 (100) | 1/23 (4) | 3/8 (37) | 3/24 (12) | 1/1 (100) |
| *E. coli* | 6/8 (75) | 15/16 (94) | 4/4 (100) | 15/27 (56) | 13/15 (87) | 10/16 (62) | 6/19 (32) | 8/15 (53) | 4/24 (17) | 7/7 (100) |
| *K. pneumoniae* | 3/3 (100) | 4/4 (100) | 0 | 4/5 (80) | 4/4 (100) | 3/4 (75) | 0 | 0 | 3/6 (50) | 3/3 (100) |
| *P. aeruginosa* | 1/3 (33) | 0 | 0 | 1/3 (33) | 1/1 (100) | 1/1 (100) | 0 | 0 | 0 | 0 |
| *S. pneumoniae* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *P. mirabilis* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *C. freundii* | 0 | 2/2 (100) | 0 | 2/2 (100) | 1/2 (50) | 1/2 (50) | 0 | 0 | 23 | 23 |

**[Table/Fig-2]:** Resistance pattern of isolated organisms (organisms vs antimicrobials)

Co-Cotrimoxazole, Na-Nalidixic acid, Nx-Norfloxacin, Ofx-Ofloxacin, Cip-Ciprofloxacin, G-Gentamicin, Amp-ampicillin

| Name of AMAs | S n (%) | MS n (%) | R n (%) | C/S not performed n (%) |
|---|---|---|---|---|
| Amikacin | 41 (54.7) | 1 (1.3) | 4 (5.3) | 29 (38.7) |
| Co-amoxiclav | 11 (14.7) | 4 (5.3) | 16 (21.3) | 44 (58.7) |
| Azithromycin | 9 (12.0) | 1 (1.3) | 2 (2.7) | 63 (84.0) |
| Ceftazidime | 2 (2.7) | 1 (1.3) | 24 (32.0) | 48 (64.0) |
| Cephalexin | 13 (17.3) | 3 (4.0) | 12 (16.0) | 47 (62.7) |
| Chloramphenicol | 28 (37.3) | 0 | 6 (8.0) | 41 (54.7) |
| Ciprofloxacin | 16 (21.3) | 3 (4.0) | 11 (14.7) | 45 (60.0) |
| Cotrimoxazole | 17 (22.7) | 2 (2.7) | 36 (48.0) | 20 (26.7) |
| Erythromycin | 13 (17.3) | 2 (2.7) | 9 (12.0) | 51 (68.0) |
| Gentamicin | 46 (61.3) | 2 (2.7) | 11 (14.7) | 16 (21.3) |
| Nalidixic acid | 3 (4.0) | 0 | 19 (25.3) | 53 (70.7) |
| Nitrofurantoin | 5 (6.7) | 1 (1.3) | 0 | 69 (92.0) |
| Norfloxacin | 8 (10.7) | 0 | 16 (21.3) | 51 (68.0) |
| Ofloxacin | 40 (53.3) | 7 (9.3) | 7 (9.3) | 21 (28.0) |
| Tetracycline | 19 (25.3) | 0 | 13 (17.3) | 43 (57.3) |
| Tobramycin | 4 (5.3) | 0 | 1 (1.3) | 70 (93.3) |
| Vancomycin | 32 (42.7) | 2 (2.7) | 0 | 41 (54.7) |
| Cefotaxime | 0 | 0 | 5 (6.7) | 70 (93.3) |
| Ampicillin | 0 | 0 | 12 (16.0) | 63 (84.0) |
| Amoxycillin | 4 (5.3) | 0 | 3 (4.0) | 68 (90.7) |

**[Table/Fig-3]:** Antimicrobial agents with sensitivity pattern (overall organisms)

**Note:** AMAs-antimicrobial agents, S-sensitive, MS-moderately sensitive, R-resistance, C/S-culture sensitivity

[Table/Fig-4] illustrates the details on prescribing pattern of antimicrobials. The column 'correct agents' indicates that the agents prescribed before C/S was sensitive. Likewise, the column 'incorrect agents' represents that the agents prescribed before C/S was either moderately sensitive or resistant, whereas the last column illustrates that C/S was not performed for the antimicrobial agents but prescribed.

| Name of AMAs | Correct agent n/N (%) | Incorrect agent n/N (%) | Prescribed but not sure n/N (%) |
|---|---|---|---|
| Amikacin | 1/2 (50) | 0 | 1/2 (50) |
| Coamoxiclav | 2/4 (50) | 2/4 (50) | 0 |
| Azithromycin | 1/2 (50) | 1/2 (50) | 0 |
| Chloramphenicol | 1/1 (100) | 0 | 0 |
| Ciprofloxacin | 2/5 (40) | 1/5 (20) | 2/5 (40) |
| Cotrimoxazole | 1/3 (33) | 2/3 (67) | 0 |
| Erythromycin | 1/3 (33.3) | 1/3 (33.3) | 1/3 (33.3) |
| Gentamicin | 7/12 (58.3) | 5/12 (41.7) | 0 |
| Nitrofurantoin | 0 | 0 | 3/3 (100) |
| Norfloxacin | 1/3 (33) | 2/3 (67) | 0 |
| Ofloxacin | 4/9 (44.5) | 3/9 (33.3) | 2/9 (22.2) |
| Vancomycin | 2/2 (100) | 0 | 0 |
| Metronidazole | 0 | 0 | 7/7 (100) |
| Cloxacillin | 0 | 0 | 7/7 (100) |
| Ceftazidime | 2/2 (100) | 0 | 0 |
| Cefuroxime | 0 | 0 | 3/3 (100) |
| Ceftriaxone | 0 | 0 | 9/9 (100) |
| Cefotaxime | 0 | 0 | 10/10 (100) |
| Cefixime | 0 | 0 | 6/6 (100) |
| Ampicillin+Cloxacillin | 4 (5.3) | 0 | 4/4 (100) |

**[Table/Fig-4]:** Prescribing pattern of antimicrobials before C/S

## DISCUSSION

The main purpose of the present study was to determine the culture sensitivity, particularly the resistance pattern of the common bacteria responsible for causing infectious complications among the patients visiting Nobel Teaching Hospital, Biratnagar, Nepal. The study also intended to analyze the prescribing pattern of antimicrobials before carrying out the culture sensitivity test. There was a common practice of not stating the diagnosis of the diseases (88%) in culture reports. This might be due to the reason that the hospital microbiology laboratory would have been receiving the C/S request form from different clinical departments of the hospital without having diagnosis of the disease stated. *Staphylococcus aureus* and *Escherichia coli* were the most common bacteria (78%) accountable for infectious diseases among the patients visiting this teaching hospital which is consistent with the findings suggested by Vanitha et al., [6]. Bhatt and Lakhe in their study also found the highest prevalence of the above two bacteria as the most common cause of wound infection [11].

The limited numbers of C/S reports over a period of 5 months duration reveals that prescribing antimicrobials at this hospital is mostly empirical in nature. Treating infectious illnesses with single antimicrobial agent was predominant (68%) at the hospital which indicates a healthier practice as compared to the study conducted in a tertiary care hospital of Tamilnadu, India which found 54.58% [12].

Third generation cephalosporins were the most commonly prescribed agents for most of the infections which comply with the findings of other studies [13,14]. However, the study conducted at another teaching hospital of eastern Nepal found an opposite pattern in which ciprofloxacin was the most widely used antimicrobial [15]. Excitingly, this study found no use of ciprofloxacin but ofloxacin. Although ceftriaxone and cefotaxime were the highly favoured and prescribed agents, C/S was performed only in about 7% of the cases of cefotaxime and not at all in the case of ceftriaxone. *Escherichia coli* and *Staphylococcus aureus* were resistant to cefotaxime but more sensitive to gentamicin and ofloxacin, the next highly prescribed antimicrobials. The finding highlights gentamicin and ofloxacin as better choices against these 2 most commonly occurring organisms, but there is a need of encouraging C/S tests for ceftriaxone and cefotaxime to draw the final conclusion. On the contrary, Karlowsky et al., reported that Escherichia coli and Staphylococcus aureus were highly sensitive to ceftriaxone and cefotaxime in United States [16].

A noticeable fraction of C/S tests were evident only in certain cases of antimicrobials such as gentamicin 59 (79%), cotrimoxazole 55 (73%) and ofloxacin 54 (72%). However, C/S was either less or not performed in majority of the cases. Therefore, it is imperative to expand the C/S testing for other commonly prescribed antimicrobial agents. Although cotrimoxazole and norfloxacin were among the least prescribed, they were the most incorrectly prescribed agents followed by gentamicin, ofloxacin, co-amoxiclav, azithromycin and erythromycin. Thus, it is crucial to know the susceptibility pattern of pathogens before selecting the most appropriate antimicrobial agents.

## CONCLUSION

Bacterial resistance and inappropriate prescribing of antimicrobials are important issues leading to irrational use of antimicrobials and unnecessary burden on patients. There is a need for expanding antimicrobial susceptibility testing to commonly used or prescribed antimicrobials to draw clear pictures about their susceptibility and the resistance towards selecting the most appropriate antibiotics. It is also necessary to sensitize the prescribers to mention the probable diagnosis in the form sending for the C/S test.

The study would also like to highlight the need for better regulation of using antimicrobials, educating the medical community and even the public about appropriate use of antimicrobials.

## LIMITATIONS OF THE STUDY

As diagnosis of the diseases was not mentioned in majority of the cases the study could not be able to clearly correlate the types of disease/infection, the bacteria involved and the antimicrobials prescribed. The sample size was short.

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