International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

# Assessment of Resistance and Susceptibility Pattern of Antibiotics in Tertiary Care Teaching Hospital in Eastern Gujarat

**Running Title**
Assessment of Resistance and Susceptibility Pattern of Antibiotics in Tertiary Care Teaching Hospital: A Prospective Observational Study

**Naisargi Pathak[1], Disha Patel[2], Rishabh Malik[3], Dr. Jitendra Vaghasiya[4]**

[1]Parul Institute of Pharmacy, Parul University, Vadodara, Gujarat - 391760, India
Corresponding Author Email: *pathaknaisargi05[at]gmail.com*
Contact: +91 7698580247

[2, 3]Parul Institute of Pharmacy, Parul University, Vadodara, Gujarat - 391760, India

[4]Parul College of Pharmacy and Research, Parul University, Ahmedabad, Gujarat - 380058, India

Corresponding Authors

Naisargi Pathak
Disha Patel
Rishabh Malik

Parul Institute of Pharmacy, Parul University, Vadodara, Gujarat-391760, India
Email: pathaknaisargi05[at]gmail.com

**Abstract:** ***Antibiotic resistance patterns are constantly changing due to superbugs. Continuous monitoring of antibiotic Resistance and Susceptibility testing is required prior to prescribing antibiotics. Globally, many deaths are reported due to antimicrobial resistance. If people not change the way of using the antibiotics the newer antibiotics will face the same resistance problem after few years. This study was conducted in tertiary care teaching hospital in Eastern Gujarat to identify most common resistance and sensitive bacteria, the resistance pattern of bacteria to various antibiotic, and most resistant bacterial species. Where it showed that gram - negative infections are increasing. In which, most prominent suspected bacteria are E. coli, Pseudomonas aeruginosa, Klebsiella spp., and Klebsiella pneumoniae. And during the study we found that total 38 different antibiotics are showing/ forming resistance towards suspected bacteria.***

**Keywords:** Antibiotic, Resistance, Susceptibility, Eastern Gujarat, Bacterial species

## 1. Introduction

Now - a - days antimicrobial resistance is one of the most familiar topic. Another pandemic, which is caused due to several reasons like misuse and overuse of antibiotics in recent years, which becomes less effective against the infection. It takes place due to superbugs like bacteria growing, changing and spreading very fast (the bacterial strain forms resistance to most of the antibiotic). Other reasons which are leading to resistance are over - prescription of antibiotics, patient not completing the entire antibiotic course, poor hygiene, and absence of new antibiotics being discovered. Antimicrobial resistance is a global concern for the whole world, according to the WHO report of 2021, it has been stated that pathogens have acquired new mechanisms of resistance. Multi and pan - resistant bacteria are alarming on which current antibiotics are failing to treat infection. WHO has identified 32 antibiotics which are in the list of priority pathogen from which 6 were classified as innovative. Globally, deaths are reported due to antimicrobial resistance where treatment is really difficult so new antibacterial agents are required for the treatment example was presented in WHO report for treating carbapenem - resistant gram - negative bacterial infection is identified in WHO priority pathogen list. But if people not change the way of using the antibiotics the newer antibiotics will face the same resistance problem after few years. [1 - 3] So this study was performed to identify the Antimicrobial resistance among the population of eastern Gujarat.

**Aim and Objective:**
The aim of this study was to Assess the Resistance and Susceptibility pattern of antibiotics in tertiary care teaching hospital in eastern Gujarat. The objectives were to find most common resistance and sensitive bacteria by using culture sensitivity test, the resistance pattern of bacteria to various antibiotic used in hospital, and to categorize most resistant bacterial species found in different disease condition.

## 2. Method

The study was conducted at Parul sevashram hospital, vadodara for the duration of 6 months. It was a prospective observational study. Total 350 subject data was taken in this study, out of which only 160 subject data was used as those showed the positive culture reports. The data of subjects was

collected from IPDs of the Hospital. Patient consent forms and Patient data collection forms were prepared.

**Inclusive Criteria**

1) Patients on antibacterial treatment
2) Patients with culture sensitivity reports

**Exclusive Criteria**

1) Patients on cancer Chemotherapy
2) Pregnant and lactating Patients
3) Psychiatric Patients
4) Patients on Anti-fungal and Anti-Viral therapy

**Data analysis**

Data were processed in Graphed prism. Results were shown as standard deviation for quantitative variables and percentage for categorical variables.

## 3. Result

In this study total 350 subjects with culture sensitivity test data were taken, out of which 160 (45.71%) subjects' data were taken for further study as it showed the positive bacterial growth.

**Table 1:** Comparison of gram - stain in Male and Female

| | Male | Female |
|---|---|---|
| Gram positive | 20 (21%) | 12 (19%) |
| Gram negative | 76 (79%) | 52 (81%) |

Infection with gram positive and gram-negative bacterial species among the subjects were observed in which male patients with negative stain infection were highly significant (p value= 0.7237) than female patients. Shown in table 1.

**Table 2:** Prevalence of E. coli in this study v/s Meshwa et. al., 2022

| | Gandhinagar | Vadodara |
|---|---|---|
| E. coli | 70 (47%) | 39 (24%) |
| Other than E. coli | 80 (53%) | 121 (76%) |

Total 23 bacteria species were suspected during the study, out of which E. coli infection was observed to be prominent. If we compare the prevalence of E. coli infection in this study with Meshwa at. el., study, there is significant difference (p value= 0.0007). Shown in table 2.

**Table 3:** Prevalence of infection with different bacterial species in different patients age groups

| | E. coli | Others |
|---|---|---|
| 51 - 70 | 11 (28%) | 41 (34%) |
| Other than 51 - 70 | 28 (72%) | 80 (66%) |

The age group 51 - 70 was observed to have highest number of patients with infection in this study. The above data (Table 3) shows that the prevalence of infection in age group of 51 - 70 compare to other age groups had no statistically significant difference (p value= 0.3590).

**Table 4:** Prevalence of infection with different bacterial species in patients admitted to different department of hospital

| | Klebsiella Pneumoniae | Other than Klebsiella Pneumoniae |
|---|---|---|
| ICU | 12 (75%) | 47 (33%) |
| Other than ICU | 4 (25%) | 97 (67%) |

It was observed that most samples of Culture sensitivity test were collected from ICU department. And Klebsiella Pneumoniae infected subjects' number was the highest. If we compare the klebsiella Pneumoniae infected patients in ICU with the number of patients in other ward with the same, than the number of patients with K. Pneumoniae infection were observed to be significantly higher (p value= 0.0001) in ICU. Shown in Table 4.

**Table 5:** Culture Vs Bacteria

| | Urine | Blood | Pus | Sputum | ET | Others |
|---|---|---|---|---|---|---|
| E. coli | 23 | 1 | 9 | 1 | 1 | 4 |
| Pseudomonas Aeruginosa | 10 | 1 | 2 | 3 | 2 | 5 |
| Klebsiella spp | 10 | 2 | 4 | 1 | 0 | 0 |
| Klebsiella Pneumoniae | 0 | 2 | 2 | 3 | 2 | 7 |
| Staphylococcus aureus | 0 | 1 | 7 | 0 | 0 | 2 |
| Others | 10 | 25 | 3 | 5 | 7 | 5 |

The 5 most prominent suspected bacterial infection seen in this study were E. coli, Pseudomonas Aeruginosa, Klebsiella spp, Staphylococcus aureus and the specimen which was showing most suspected bacterial growth was Urine culture.

**Table 6:** Comparison of resistivity rate and susceptibility rate between this study and meshwa et. al., study against E. coli infection.

| | Vadodara | | | Gandhinagar | | | |
|---|---|---|---|---|---|---|---|
| Antibiotics | No of isolates | R | S | No of isolates | R | S | p value |
| Amikacin | 39 | 09 (23%) | 30 (77%) | 68 | 5 (7%) | 63 (93%) | 0.0015 |
| Ampicillin | 21 | 21 (100%) | 0 | 70 | 62 (89%) | 08 (11%) | 0.0006 |
| Amoxicillin/clavulanate | 34 | 24 (71%) | 10 (29%) | 69 | 47 (68%) | 22 (32%) | 0.645 |
| Ceftazidime | 25 | 19 (76%) | 06 (24%) | 70 | 50 (71%) | 20 (29%) | 0.4231 |
| Ciprofloxacin | 39 | 35 (90%) | 04 (10%) | 69 | 52 (75%) | 17 (25%) | 0.0052 |
| Colistin | 3 | 02 (67%) | 01 (33%) | 64 | 02 (3%) | 62 (97%) | 0.0001 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cefoxitin | 20 | 15 (75%) | 05 (25%) | 11 | 08 (73%) | 03 (27%) | 0.7471 |
| Cefixime | 21 | 19 (90%) | 02 (10%) | 69 | 49 (71%) | 20 (29%) | 0.0007 |
| Ceftriaxone | 36 | 34 (94%) | 02 (6%) | 70 | 48 (69%) | 22 (31%) | 0.0001 |
| Doripenem | 1 | 0 | 01 (100%) | 15 | 01 (7%) | 14 (93%) | 0.0071 |
| Ertapenem | 31 | 12 (39%) | 19 (61%) | 20 | 02 (10%) | 18 (90%) | 0.0001 |
| Fosfomycin | 36 | 01 (3%) | 35 (97%) | 11 | 02 (18%) | 09 (82%) | 0.0005 |
| Cefuroxime | 14 | 14 (100%) | 0 | 70 | 51 (73%) | 19 (27%) | 0.0001 |
| Gentamicin | 39 | 14 (36%) | 25 (64%) | 68 | 20 (29%) | 48 (71%) | 0.2906 |
| Imipenem | 18 | 05 (3%) | 13 (97%) | 70 | 02 (3%) | 68 (97%) | 0.0001 |
| Levofloxacin | 3 | 02 (67%) | 01 (33%) | 69 | 54 (78%) | 15 (22%) | 0.0815 |
| Meropenem | 18 | 06 (33%) | 12 (67%) | 70 | 02 (3%) | 68 (97%) | 0.0001 |
| Minocycline | 2 | 01 (50%) | 01 (50%) | 65 | 41 (63%) | 24 (37%) | 0.0001 |
| Nitrofurantoin | 18 | 02 (11%) | 16 (89%) | 62 | 02 (3%) | 60 (97%) | 0.0266 |
| Nalidixic Acid | 23 | 19 (83%) | 04 (17%) | 9 | 09 (100%) | 0 | 0.0001 |
| Norfloxacin | 23 | 18 (78%) | 05 (22%) | 60 | 49 (82%) | 11 (18%) | 0.4795 |
| Ofloxacin | 23 | 19 (83%) | 04 (17%) | 69 | 55 (80%) | 14 (20%) | 0.5849 |
| Piperacillin + Tazobactam | 36 | 25 (69%) | 11 (31%) | 67 | 16 (24%) | 51 (76%) | 0.0001 |
| Tigecycline | 14 | 0 | 14 (100%) | 67 | 33 (49%) | 34 (51%) | 0.0001 |
| Ticarcillin | 23 | 21 (91%) | 02 (9%) | 9 | 09 (100%) | 0 | 0.0021 |
| Trimethoprim + Sulfamethoxazole | 37 | 24 (65%) | 13 (35%) | 9 | 07 (78%) | 02 (22%) | 0.0417 |

The data of susceptibility and resistivity rate against E. coli infection of some antibiotics like Amikacin, Ampicillin, Ciprofloxacin, Colistin, Cefixime, Ceftriaxone, Doripenem, Ertapenem, Fosfomycin, Cefuroxime, Imipenem, Meropenem, Minocycline, Nitrofurantoin, Nalidixic Acid, Piperacillin + Tazobactam, Tigecycline, Ticarcillin, Trimethoprim + Sulfamethoxazole were statistical significance between our study and Meshwa at. el., study. Shown in Table 6.

**Table 7:** Comparison of resistivity rate and susceptibility rate between this study and Meshwa et. al., against Pseudomonas Aeruginosa infection

| | Vadodara | | | Gandhinagar | | | |
|---|---|---|---|---|---|---|---|
| Antibiotics | No. of isolates | R | S | No. of isolates | R | S | P - value |
| Amikacin | 22 | 14 (64%) | 08 (36%) | 19 | 11 (58%) | 08 (42%) | 0.3844 |
| Ceftazidime | 23 | 14 (61%) | 09 (39%) | 19 | 12 (63%) | 07 (37%) | 0.7708 |
| Cefoperazone + Sulbactam | 21 | 14 (67%) | 07 (33%) | 19 | 10 (53%) | 09 (47%) | 0.0433 |
| Cefepime | 22 | 13 (59%) | 09 (41%) | 19 | 14 (74%) | 05 (36%) | 0.0246 |
| Ciprofloxacin | 22 | 17 (77%) | 05 (23%) | 19 | 13 (68%) | 06 (32%) | 0.7542 |
| Gentamicin | 23 | 15 (65%) | 08 (35%) | 19 | 11 (58%) | 08 (42%) | 0.309 |
| Imipenem | 23 | 16 (70%) | 07 (30%) | 19 | 03 (16%) | 16 (84%) | 0.0001 |
| Levofloxacin | 23 | 18 (78%) | 05 (22%) | 18 | 13 (72%) | 05 (28%) | 0.3272 |
| Meropenem | 22 | 16 (73%) | 06 (27%) | 19 | 06 (32%) | 13 (68%) | 0.0001 |
| Nitrofurantoin | 1 | 01 (100%) | 0 | 18 | 02 (11%) | 16 (89%) | 0.0001 |

The data of susceptibility and resistivity rate against Pseudomonas Aeruginosa of some antibiotics like Cefoperazone + Sulbactam, Cefepime, Imipenem, Meropenem and Nitrofurantoin were statistical significance between our study and Meshwa at. el., study. Shown in Table 7.

## 4. Discussion

The emergence and spread of antibiotic resistance is a global concern now - a - days. Many reports showed the death due to antibiotic resistance. A review on AMR was performed in 2016 which estimated 10 million deaths each year due to AMR by 2050 if situation left unchecked. In 2019 it was found that, 1.27 million deaths can be caused due to AMR. [4]

This was prospective observation study where total of 350 data were collected out of which 160 were taken for analysis as they had positive culture reports.

In this study the number of the gram negative infection (76%) among male population was observed to be higher than gram positive infection (21%), similar to *Meshwa Soni, et al.,* study.

Total 23 different species of bacteria were suspected during this study. Out of which E. coli (47%) was observed to be the prominent Bacteria. Similar to *Meshwa et. al.,* study.

For this study every age group of individual was enrolled, in which we found that age group of 51 - 70 years (28%) showed most positive culture reports with E. coli compare to other age group Similar to *A. Lefort et. al., study.*

Different ward's data were collected during this study. In which it was observed that ICU showed most positive culture with suspected Klebsiella Pneumoniae (75%) infection. Similar to *Ali Al Bshabshe et. al.,* study.

Total of 11 different culture for culture sensitivity were observed to be collected, in which urine culture was performed often with positive suspected E. coli (n=23) infection. Similar to M*eshwa et. al.,* study.

In E. coli infection, the susceptibility and resistance rate of Amikacin, Ampicillin, Ciprofloxacin, Colistin, Cefixime, Ceftriaxone, Doripenem, Ertapenem, Fosfomycin, Cefuroxime, Imipenem, Meropenem, Minocycline, Nitrofurantoin, Nalidixic Acid, Piperacillin + Tazobactam, Tigecycline, Ticarcillin, Trimethoprim + Sulfamethoxazole showed statistical significance between our study 2017 and *Meshwa at. el., study.* and in Pseudomonas Aeruginosa the susceptibility and resistance rate of antibiotics like Cefoperazone + Sulbactam, Cefepime, Imipenem, Meropenem and Nitrofurantoin were statistically significant between our study and *Meshwa at. el., study.*

However, we did not have the capacity to conduct a 16S–rRNA gene sequence analysis to identify bacterial species, and this is a significant weakness of the study.

## 5. Conclusion

Antibiotic resistance patterns are constantly changing. Continuous monitoring of antibiotic Resistance and susceptibility testing is required prior to prescribing antibiotics. After analysing the CST reports of different samples, in this study we concluded that gram - negative infections are increasing. In which most prominent suspected bacteria are E. coli, Pseudomonas aeruginosa, Klebsiella spp., and Klebsiella pneumoniae. During the study we found that total 38 different antibiotics are showing/ forming resistance towards suspected bacterias. And ICU department data is showing most patients with infection. These data can be used to monitor antibiotic susceptibility trends, develop local antibiotic policy, assist clinicians in selecting appropriate antibiotic therapy, to prevent indiscriminate use of antibiotics, and also helpful for Antimicrobial Stewardship Programs.

## Preparation

**Sources of funding:**
This was non - funded study.

**Ethics Approval**
The study was conducted after obtaining approval of PARUL UNIVERSITY INSTITUTIONAL ETHICS COMMITTEE FOR HUMAN RESEARCH (PUIECHR). Approval Number: PUIECHR/PIMSR/00/081734/5204

**Declaration of Interest:**
The work described has not been published previously. It is not under consideration for publication elsewhere, its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and if accepted, it will not be published elsewhere in the same form.

**Acknowledgements**
We express our heartfelt appreciation to Dr. Jitendra Vaghasiya for his exceptional guidance, as well as our gratitude to Hospital Parul Sevashram and the Parul Ethics Committee for their support in facilitating our research endeavors.

**Authorship**
All corresponding authors have made substantial contributions to all the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted.

## References

[1] Antibiotic Resistance. National Health Service.2022.
[2] Antimicrobial resistance. World Health Organization.2021
[3] Andrew Duong.6 Factors That Have Caused Antibiotic Resistance. TIPS.2015.
[4] Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: a global multifaceted phenomenon. Pathog Glob Health.2015; 109 (7): 309 - 18.