



ANTIBIOTIC SUSCEPTIBILITY PATTERN OF PSEUDOMONAS AERUGINOSA ISOLATED FROM NOSOCOMIAL INFECTIONS IN A TERTIARY CARE HOSPITAL

Surbhi Verma^{1*}, Dr Kailash Jatav², Aneesh Sharma³,

¹PhD. Scholar, Department of Microbiology, Index Medical college hospital & research centre, Indore, Madhya Pradesh.

²Associate professor, Department of Microbiology, Index Medical college hospital & research centre, Indore, Madhya Pradesh.

³PhD. Scholar, Department of Microbiology, Index Medical college hospital & research centre, Indore, Madhya Pradesh.

***Corresponding Author:** Surbhi Verma

PhD. Scholar, Department of Microbiology, Index Medical college hospital & research centre, Indore, Madhya Pradesh.

ABSTRACT

INTRODUCTION: Pseudomonas aeruginosa is an opportunistic, non-fermenting Gram-negative bacillus that has become a leading cause of healthcare-associated (nosocomial) infections worldwide, especially in critically ill and immunocompromised patients. The present study was designed to evaluate the antibiotic susceptibility pattern of P. aeruginosa isolated from nosocomial infections in a tertiary care hospital.

METHODS: This cross-sectional study was done in the Department of Microbiology, Index Medical College, Hospital and Research Centre, M.U. Indore MP. 300 samples from patients of all age group and both sexes were enrolled in the study. All isolates of Pseudomonas aeruginosa from a variety of clinical specimens, including pus, urine, burn wounds, sputum, bodily fluids, CSF, tracheal secretions, and patient devices were included in the study. The isolates were identified by colony morphology, Gram's staining and biochemical test according to standard laboratory test methods. In accordance with CLSI 2025 guidelines, each isolate was subjected to an AST using the Kirby-Bauer disc diffusion method.

RESULTS: Out of 300 patients, 225 (75%) were male and 75 (25%) were female. Most commonly affected age group was 46-60 years (30%), followed by 61-75 years (24.7%). Pseudomonas aeruginosa was most commonly isolated from pus samples (39.7%) followed by sputum sample (32.3%), urine sample (10.3%). Pseudomonas aeruginosa isolates were 100% susceptible to colistin and polymyxin B. 94.7% isolates were susceptible to imipenem and meropenem. 87.3% isolates were susceptible to piperacillin tazobactam. 81.7% isolates were susceptible to amikacin. 75.7% isolates were susceptible to ciprofloxacin. 73.7% isolates were susceptible to gentamicin. 70.3% isolates were susceptible to netilmicin. 63.3% isolates were susceptible to carbenicillin. 52% isolates were susceptible to aztreonam. Only 33.4% isolates were susceptible to ceftazidime.

CONCLUSION: The study provides updated, hospital-specific antibiotic susceptibility data that can assist clinicians in selecting appropriate empirical and targeted therapy for Pseudomonas aeruginosa infections.

INTRODUCTION

Pseudomonas aeruginosa is an opportunistic, non-fermenting Gram-negative bacillus that has become a leading cause of healthcare-associated (nosocomial) infections worldwide, especially in critically ill and immunocompromised patients. (1) *P. aeruginosa* prefers moist environments, and in hospitals they can be isolated from nebulizers, dialysate fluids, saline, on catheters and other diagnostic and therapeutic devices. They can grow in distilled water using, dissolved carbon dioxide and residual sulphur, phosphorus, iron and divalent cations as carbon and essential nutritional substrates. (2) Nosocomial infections caused by this pathogen include ventilator-associated pneumonia, catheter-associated urinary tract infections, bloodstream infections, surgical-site infections and wound infections. (3)

The treatment of *P. aeruginosa* infections is increasingly challenging due to both intrinsic resistance mechanisms and the rapid acquisition of additional resistance determinants — such as efflux pumps, β -lactamases (including metallo- β -lactamases), porin loss and target modifications — resulting in multidrug-resistant (MDR) and carbapenem-resistant strains. (4,5)

The choice of empiric treatment in ICUs is difficult since there is a need to balance between broad spectrum and too narrow spectrum of antibiotic. (6,7) Several different epidemiological studies indicate that antibiotic resistance is increasing in the diversity of clinics and the regional variations in antibiotic protocols result in different resistance profiles. The emergence of multidrug-resistant (MDR) strains poses significant challenges to treatment, making antibiotic susceptibility testing crucial for guiding empirical therapy.

Therefore, the present study was designed to evaluate the antibiotic susceptibility pattern of *P. aeruginosa* isolated from nosocomial infections in a tertiary care hospital.

MATERIAL AND METHODS

This cross-sectional study was done in the Department of Microbiology, Index Medical College, Hospital and Research Centre, M.U. Indore MP. Study was planned for the period from July 2023 to July 2025. 300 samples from patients of all age group and both sexes were enrolled in the study. Culture-positive non-duplicate isolates identified as *Pseudomonas aeruginosa* by standard microbiological methods were included in the study.

Institutional Ethical Committee gave their clearance for the study to be conducted.

Using a practical sample collection method, all isolates of *Pseudomonas aeruginosa* from a variety of clinical specimens, including pus, urine, burn wounds, sputum, bodily fluids (ascitic fluid, pleural fluid, etc.), CSF, tracheal secretions, and patient devices (urinary catheter, endotracheal tube, i.v. catheter, tracheostomy tube, etc.) from tertiary care hospitals were included in the study.

The isolates were identified by colony morphology, Gram's staining and biochemical test according to standard laboratory test methods. In accordance with CLSI 2025 guidelines (8), each isolate was subjected to an AST using the Kirby-Bauer disc diffusion method. *Pseudomonas* ATCC 27853 was used as control strain.

STATISTIC ANALYSIS: Microsoft Excel was used to enter the collected data and statistical analysis was done by applying descriptive statistics to generate percentages.

RESULTS:

Out of 300 patients, 225 (75%) were male and 75 (25%) were female. Male were affected more than females. Most commonly affected age group was 46-60 years (30%), followed by 61-75years (24.7%), 31-45years (16.3%), 16-30years (15.7%). 8.7% patients were in the age group of >75years. 3.7% patients were in the age group of 1-15years and 1% patients were in the age group of <1years.

Pseudomonas aeruginosa was most commonly isolated from pus samples (39.7%) followed by sputum sample (32.3%), urine sample (10.3%), blood sample (5.7%), tracheal swab sample (3%), bronchial washing (2.7%), pleural fluid (2.7%), throat swab (2%), endotracheal swab (1%), abscess fluid (0.67%).

In our study Pseudomonas aeruginosa isolates were 100% susceptible to colistin and polymyxin B. 94.7% isolates were susceptible to imipenem and meropenem. 87.3% isolates were susceptible to piperacillin tazobactam. 81.7% isolates were susceptible to amikacin. 75.7% isolates were susceptible to ciprofloxacin. 73.7% isolates were susceptible to gentamicin. 70.3% isolates were susceptible to netilmicin. 63.3% isolates were susceptible to carbenicillin. 52% isolates were susceptible to aztreonam. Only 33.4% isolates were susceptible to ceftazidime.

TABLE 1: Specimen wise distribution of Pseudomonas aeruginosa isolates

SPECIMEN	NUMBER	PERCENTAGE
Pus	119	39.7
Sputum	97	32.3
Urine	31	10.3
Blood	17	5.7
Tracheal swab	9	3
Bronchial washing	8	2.7
Pleural fluid	8	2.7
Throat swab	6	2
Endotracheal swab	3	1
Abscess fluid	2	0.67
TOTAL	300	100

TABLE 2: Antibiotic susceptibility pattern of Pseudomonas aeruginosa isolates

ANTIBIOTIC	RESISTANT	INTERMEDIATE	SUSCEPTIBLE
AMIKACIN	55 (18.3%)	0	245 (81.7%)
GENTAMICIN	79 (26.3%)	0	221 (73.7%)
CIPROFLOXACIN	58 (19.3%)	15 (5%)	227 (75.7%)
CEFTAZIDIME	181 (60.3%)	19 (6.3%)	100 (33.4%)
IMIPENEM	16 (5.3%)	0	284 (94.7%)
MEROPENEM	16 (5.3%)	0	284 (94.7%)
CARBENICILLIN	110 (36.7%)	0	190 (63.3%)
AZTREONAM	124 (41.3%)	20 (6.7%)	156 (52%)
PIPERACILLIN TAZOBACTAM	38 (12.7%)	0	262 (87.3%)
NETILMICIN	89 (29.7%)	0	211 (70.3%)
COLISTIN	0	0	300 (100%)
POLYMYXIN B	0	0	300 (100%)

DISCUSSION

Pseudomonas aeruginosa is a prime example of an opportunistic nosocomial organism that can cause a variety of infections and significantly increase morbidity in individuals with impaired immune systems. The mortality rate from nosocomial pseudomonal pneumonia is about 70% even with treatment. (9) Unfortunately, P. aeruginosa exhibits resistance to several medicines, making it difficult to choose the best course of action. (10)

In our study, out of 300 patients, 225 (75%) were male and 75 (25%) were female. Male were affected more than females. Study of Javiya VA, et al. (11) revealed that The numbers of male patients 34 out of 56 (60.7%) were more as compared to female patients 22 (39.3%). Similar results were also reported from other studies. (12,13,14,15,16)

In present study, Most commonly affected age group was 46-60 years (30%), followed by 61-75years (24.7%). Study of Javiya VA, et al. (11) revealed that Pseudomonas aeruginosa were more common in age group 60-69 years, (25%) followed by age group 30-39 years and 50-59 years (14.2%). Similar finding was also reported by another researcher (15,16,17).

Both the very young and the very elderly are often more vulnerable to nosocomial and community-acquired illnesses; age, as impacted by these nonspecific factors, is associated with lower resistance at either end of the spectrum. Surgery and the presence of chronic diseases alter host resistance. Also patients in older age group have comorbidities due to other underlying infection and disease, and have decreased immunity and stay for longer time in hospitals.

In present study, *Pseudomonas aeruginosa* was most commonly isolated from pus samples (39.7%) followed by sputum sample (32.3%), urine sample (10.3%), blood sample (5.7%), tracheal swab sample (3%), bronchial washing (2.7%), pleural fluid (2.7%), throat swab (2%), endotracheal swab (1%), abscess fluid (0.67). Various independent studies also reported that the *Pseudomonas aeruginosa* infections were common in the pyogenic infections as 50.7% and 55.35% (18,19). The reasons of such high incidence of *pseudomonas* pyogenic infections may be poor sanitary conditions, crowded wards and more number of patients to visitors' interaction in hospitals.

In our study *Pseudomonas aeruginosa* isolates were 100% susceptible to colistin and polymyxin B. 94.7% isolates were susceptible to imipenem and meropenem. 87.3% isolates were susceptible to piperacillin tazobactam. 81.7% isolates were susceptible to amikacin. 75.7% isolates were susceptible to ciprofloxacin. 73.7% isolates were susceptible to gentamicin. 70.3% isolates were susceptible to netilmicin. 63.3% isolates were susceptible to carbenicillin. 52% isolates were susceptible to aztreonam. Only 33.4% isolates were susceptible to ceftazidime.

All the isolates of present study including those isolated from clinical samples were susceptible to colistin and Polymyxin B, which is in agreement with the previous reports (20,21). Polymyxin B and colistin remain the mainstay of treatment for multidrug resistant *P. aeruginosa*.

Over 90% of isolates in the US were amikacin-susceptible, 80–90% were ceftazidime-susceptible, and 70–80% were ciprofloxacin and gentamicin-susceptible. (22) Ceftazidime and gentamicin susceptibilities were found in 80 and 78.4% of isolates in Trinidad and Tobago, respectively. (23) According to reports from France, the susceptibility rates of *P. aeruginosa* to ceftazidime and ciprofloxacin are 78.5 and 61.7%, respectively. (24) Only 25% of isolates in Russia were sensitive to gentamicin, indicating increased resistance.(25)

In most of the regions of India, sensitivity to imipenem has been recorded very high. In a similar study in India. Sensitivity of 90% to imipenem (26). The imipenem sensitivity as 88.2% in Puducherry and Solapur, India (27,28). Sensitivity of 72.4% to imipenem in Delhi, India has been reported (29).

CONCLUSION

The study provides updated, hospital-specific antibiotic susceptibility data that can assist clinicians in selecting appropriate empirical and targeted therapy for *Pseudomonas aeruginosa* infections. This can lead to improved treatment outcomes, reduced therapeutic failure, and decreased morbidity and mortality associated with resistant infections.

REFERENCES

1. Do Toka W, Sjahril R, Hamid F. Antibiotic Susceptibility Pattern in Clinical Isolates of *Pseudomonas aeruginosa*. Nusantara Med Sci J. 2021;6(2):66-73. doi:10.20956/nmsj.v6i2.14172.
2. Topley. & Wilson. (2006). Microbiology and Microbial infections. 10th edition. *Pseudomonas*. 690
3. Unhas JournPang Z, Raudonis R, Glick B R, Lin T-J, Cheng Z. Antibiotic resistance in *Pseudomonas aeruginosa*: mechanisms and alternative therapeutic strategies. Biotechnol Adv. 2019;37:177-192. doi:10.1016/j.biotechadv.2018.11.013.
4. "Antimicrobial resistance in clinical patterns of *Pseudomonas aeruginosa*." J Med Sci. 2012
5. Esfahani SNM, et al. Antibiotic Susceptibility Pattern of Nosocomial and Community-Acquired *Pseudomonas aeruginosa* in Isfahan: A Prospective Multicenter Study. J Kerman Univ Med Sci. 2024.

6. Javiya VA, Ghatak SB, Patel KR, Patel JA. Antibiotic susceptibility patterns of *Pseudomonas aeruginosa* at a tertiary care hospital in Gujarat, India. *Indian J Pharmacol*. 2008;40(5):230–4. [PubMed ID: 20040963].
7. Harris AD, Jackson SS, Robinson G, et al. *Pseudomonas aeruginosa* colonisation in the ICU: prevalence, risk factors and clinical outcomes. *Infect Control Hosp Epidemiol* 2016;37(5):544–548.
8. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; 35th ed. M100-ED35. Clinical and Laboratory Standards Institute, Wayne, PA, 2025.
9. Chastre J, Trouillet JL. Problem pathogens (*Pseudomonas aeruginosa* and *Acinetobacter*). *Semin Respir Infect* 2000;15:287–98.
10. Obritsch MD, Fish DN, McLaren R, Jung R. National Surveillance of Antimicrobial Resistance in *Pseudomonas aeruginosa* isolates obtained from Intensive Care Unit Patients from 1993 to 2002. *Antimicrob Agents Chem* 2004;48:4606–10.
11. Javiya VA, Ghatak SB, Patel KR, Patel JA. Antibiotic susceptibility patterns of *Pseudomonas aeruginosa* at a tertiary care hospital in Gujarat, India. *Indian J Pharmacol* 2008;4.
12. Raakhee T, Rao US. prevalence and Resistance pattern of *Pseudomonas* strains isolated from ICU patients. *Int J Curr Microbiol Appl Sci*. 2014;3(3):527–34.
13. Al-Hasan MN, Wilson JW, Lahr BD, Eckel-Passow JE, Baddour LM. Incidence of *Pseudomonas aeruginosa* bacteraemia: a population based study. *Am J Med*. 2008;121:702–8.
14. Khan JA, Iqbal Z, Rahman SU, Ferzana K, Khan A. Report: prevalence and Resistance pattern of *Pseudomonas aeruginosa* against various antibiotics. *Pak J Pharm Sci*. 2008;21:311–5.
15. Araujo WL, Angellis DA, Azevedo JL. Direct RAPD evaluation of bacteria without conventional DNA extraction. *Braz Arch Biol Technol*. 2004;47(3):375–80.
16. Wolska K, Kot B, Jakubczak A. Phenotypic and genotypic diversity of *Pseudomonas aeruginosa* strains isolated from hospitals in siedlce (Poland). *Braz J Microbiol*. 2012; 274–82.
17. Ahmed SM, Zakridettu RP, Kottakutty S, Arya B, Shakir VPA. An Emerging multi-drug resistant pathogen in a tertiary care center in North Kerala. *Ann Biol Res*. 2012;3:2794–99.
18. Pramodhini S, Umadevi S, Seetha KS. Detection of Virulence determinant and its association with drug resistance in clinical isolates of *Pseudomonas aeruginosa* . *Int J Res Med Sci*. 2016;4(9):3917–23.
19. Hidron AI, Edwards JR, Patel J, Horan TC, Sievert DM, Pollock DA, et al. NHSN annual update: Antimicrobial-resistant pathogens associated with healthcare associated infections: Annual summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006–2007. *Infection Control and Hospital Epidemiology*. 2008;29(11):996–1011.
20. Ramakrishnan K, Rajagopalan S, Nair S, Kenchappa P, Chandrakesan SD. Molecular characterization of metallo β -lactamase producing multidrug resistant *Pseudomonas aeruginosa* from various clinical samples . *Indian J Pathol Microbiol*. 2014; 57:579–82.
21. Vahdani M, Azimi L, Asghari B, Bazmi F, Rastegar Lari A. Phenotypic screening of extended-spectrum β -lactamase and metallo- β -lactamase in multidrug-resistant *Pseudomonas aeruginosa* from infected burns. *Ann Burns Fire Disasters*. 2012; 25(2):78–81.
22. Karlowsky JA, Draghi DC, Jones ME, Thornsherry C, Friedland IR, Saham DF. Surveillance for antimicrobial susceptibility among clinical isolates of *P. aeruginosa* and *Acinetobacter baumannii* from hospitalized patients in the United states, 1998 to 2001. *Antimicrob Agents Chemother* 2003;47:1681–8
23. Fitzroy A, Orrett MD. Antimicrobial susceptibility survey of *P. aeruginosa* strains isolated from clinical sources. *J Nat Med Assoc* 2004;96:1065–9
24. Bertrand X, Thouverej M, Patry C, Balvay P, Talon D. *P. aeruginosa* : Antibiotic susceptibility and genotypic characterization of strains isolated in the intensive care unit. *Clin Microbiol Infect* 2001;7:706–8

25. Stratcheunski LS, Russian NPRS Group, Kozlov RS. Antimicrobial resistance patterns among gram -negative bacilli isolated from patients in intensive care units: Results multicentre study in Russia. Clin Microbiol Infect 1998;4:497-507
26. Patel H, Garala RN. Antibiotics Suspetibility pattern of Pseudomonas aeruginosa isolated at SSG Hospital, Baroda. J Res Med Den Sci. 2014;2(1):84–7.
27. Pramodhini S, Umadevi S, Seetha KS. Detection of Virulence determinant and its association with drug resistance in clinical isolates of Pseudomonas aeruginosa . Int J Res Med Sci. 2016;4(9):3917–23.
28. Mundhada S, Sharma A, Ingole K, Sheikh S. Prevalence of Pseudomonas aeruginosa in surgical site infection in tertiary care center. Int J Curr Microbiol App Sci. 2017;6:1202–6.
29. Biswal I, Arora B, Kasana D, Neetushree. Incidence of Multi drug resistant Pseudomonas aeruginosa isolated from burn patients and environmental teaching Institute. J Clin Diag Res. 2014;8:26–29.