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# Antimicrobial Resistance Patterns of Bacterial Isolates from Tertiary Care Hospital of North India

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***Author's contribution***

*The sole author designed, analysed, interpreted and prepared the manuscript.*

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## ABSTRACT

Antimicrobial resistance is one of the serious health threats in the world and death due to it is projected to reach up to 10 million every year by 2050. In India, the government implemented a National Action Plan on Antimicrobial Resistance (NAP-AMR) intending to develop a laboratory-based AMR surveillance system, guidelines and practices to promote the awareness of the rational use of antibiotics in healthcare communities. In this plane, only five major hospitals are included which is not sufficient to provide the actual status of AMR. The present study focused on the AMR patterns analysis for bacteria isolated from the different health units in SSB heart and multispecialty hospital, Faridabad, Haryana. Clinically relevant samples such as pus & Body fluid, respiratory, urine and blood samples from the suspected patients were screened over a period of 5 months (February to June 2021) and AMR pattern analysis was carried out by using the disc diffusion method (Kirby–Bauer test) and interpretation was made as per the guidelines of recent Clinical and Laboratory Standards Institute. The study revealed that *E. coli* was the most dominated resistant bacteria. Moreover, aminoglycosides showed 55% resistance against maximum bacterial isolates from respiratory samples while fosfomycin had higher sensitivity i.e. 85% against pathogens from urine samples. The present study concluded that regular susceptibility testing should be conducted with a defined interval to detect the current trend of resistance which helps clinicians in the effective infectious disease management and leads to reducing the burden of AMR.

*Keywords: Antimicrobial resistance; antibiogram; national action plan on antimicrobial resistance; India; current status.*

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## 1. INTRODUCTION

Bacterial infection is regarded as one of major concern of human health which causes morbidity as well as mortality and needs to immediate identification and treatment of pathogenic bacteria. At present, a number of antimicrobial agents are easily available in market and along with this it's over or misuse causes antimicrobial resistance. The World Health Organization (WHO) declared antimicrobial resistance (AMR) as one of the serious health threats at the global level [1]. In 2019, a total of 4.95 million casualties were associated with AMR out of which 1.27 million deaths occured due to bacterial AMR in the world [2] and it is projected to reach up to 10 million deaths every year by 2050 [3]. At present, India faces a higher burden of AMR as compared to other nations which might be due to poor health services, inappropriate and uncontrolled sale of antibiotics use of antimicrobial agents against infectious diseases [4]. In continuation with this, the Government of India launched a National Action Plan on Antimicrobial Resistance (NAP-AMR) intending to develop a laboratory-based AMR surveillance system, guidelines and practices to promote the awareness of the rational use of antibiotics in healthcare communities [6]. Among them, AMR surveillance is the most important strategy for evaluating the burden of AMR which helps in the development of new strategies for the treatment of microbial infections at regional, national and international levels. Previously, the Indian Council of Medical Research (ICMR) created an Antimicrobial Resistance Surveillance Network (AMRSN). In this surveillance network, only five major hospitals in India are included which is not sufficient to provide the actual status of AMR in hospitalized patients in tertiary care centers. However, there are only a few studies were reported to date on the impact of AMR in hospitalized adults [7]. These facts and figures advocated the urgent need to monitor and control the problem of AMR. The present study focused on the AMR patterns analysis for bacteria isolated from the different health units in SSB heart and multispecialty hospital, Faridabad, Haryana to establish a baseline for antibiotic prescribing in hospitals that can help in the evaluation of various national initiatives for the prevention of AMR.

## 2. METHODS

In the present investigation patients enrolled from the out-patient as well as in-patient departments of different health units of the above-mentioned hospital. All clinically relevant samples such as pus & Body fluid, respiratory, urine and blood samples from the suspected patients were screened over a period of 5 months (February to June 2021) and submitted to the microbiology laboratory. These samples were then processed and identified the bacterial isolates by following standard operating procedures to evaluate the AMR pattern a antibiogram was also developed. The AMR pattern analysis was carried out by using the disc diffusion method (Kirby–Bauer test) and interpretation was made by the guidelines of the recent Clinical and Laboratory Standards Institute [8]. Antimicrobial agents namely cephalosporins, piperacillin, tazobactum, carbapenems, fosfomycin, nitrofurantoin, ertapenem, cotrimoxazole, vancomycin, linezolid, tigecycline, colistin, amphotericin B, capsofungin were subjected for AMR analysis. Vancomycin and colistin susceptibility in Gram-positive and Gram-negative isolates respectively was evaluated by methods described in CLSI guidelines.

## 3. RESULTS

A total of 340 bacterial samples with AMR were recorded from different infection profiles out of which a total of 117 bacterial samples were drawn from urine followed by respiratory, blood and pus & body fluid samples i.e. 94, 70 and 60, respectively. *Escherichia coli* and *Pseudomonas aeruginosa* are the common AMR bacterial isolates in. Further, the maximum number of AMR *E. coli* were isolated from urine samplese while *P. aeruginosa* was recorded from respiratory samples (Table 1).

Respiratory sample analysis revealed that *Acinetobacter* spp (26 in number) was the predominant AMR bacterial isolate followed by the *Klebsiella* spp (23) and *Pseudomonas aeruginosa* (21). Moreover, most of the isolates showed resistance against aminoglycosides with 55% sensitivity while cephalosporins and fluoroquinolones showed sensitivity of 36 and 22%, respectively. In addition, piperacillin tazobactum and carbapenems have same sensivity i.e. 30% (Fig. 1).

In urine sample analysis *Escherichia coli* (84 in number) was found the dominated AMR bacterial isolates followed by the *Klebsiella* spp (15) and *Pseudomonas aeruginosa* (7). Additionally, fosfomycin had higher drug sensitivity i.e. 85% as compared to nitrofurantoin (77%) and ertapenem (73%) while fluroquinolones and cephalosporins had only 22% drug sensitivity during the study period (Fig. 2).

The AMR pattern analysis of pus and body fluid samples revealed that *E. coli* (16) had higher sensitivity followed by *Staphylococcus aureus* (13), *Klebsiella pnuemoniae* (10) and *Psuedomonas aeruginosa* (6). The maximum resistance i.e. 58.8% was shown by *S. aureus* against methicillin and described as the methicillin-resistant *Staphylococcus aureus* (MRSA). Furthermore, in the case of blood sample analysis 16 *Acinetobacter* spp, 12 *Salmonella* spp & *E. coli*, 7 *Klebsiella pnuemoniae* and 5 *Pseudomonas aeruginosa* were recorded as the AMR sensitive bacterial isolates. In terms of AMR, a total of 3.16 per 100 admissions multidrug-resistant organisms rate was observed which is a serious concern in infectious disease management.

Antibiogram showed that cephalosporins, especially from the third generation, had less sensitivity as compared to another drug of choice while in symptomatic urinary tract infections fluorquinolones can also be used as an alternative to cephalosporins as it showed a similar AMR pattern. Further, fluroquinolones also showed less sensitivity against respiratory isolates.

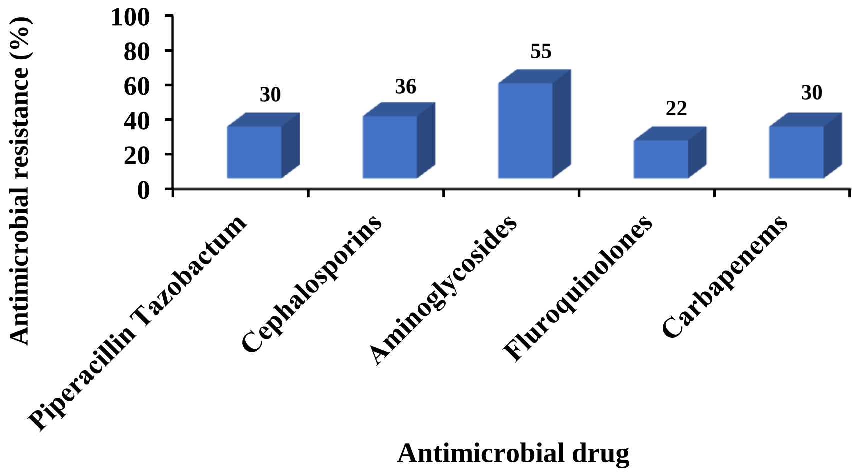


**Fig. 1. AMR pattern analysis of bacterial isolates in respiratory samples**

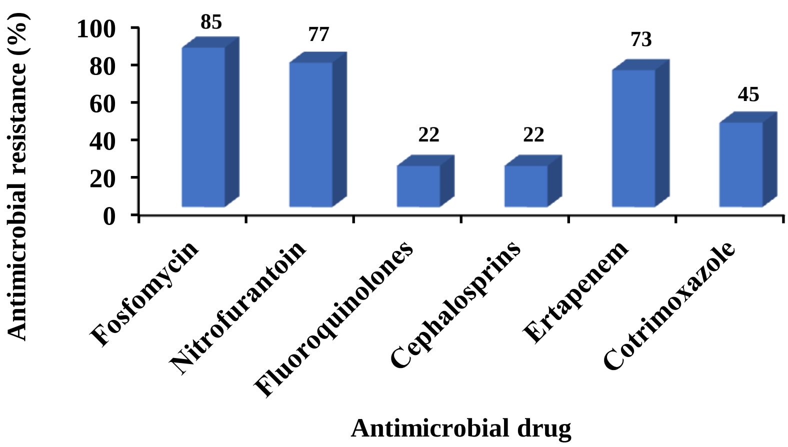


**Fig. 2. AMR pattern analysis of bacterial isolates in urine samples**

**Table 1. Distribution of AMR bacterial isolates in different clinical samples (n = 340)**

| S. No. | Isolate Name | Type of sample | | | | |
|---|---|---|---|---|---|---|
| | | **Respiratory** | **Urine** | **Pus and body fluids** | **Blood** | **Total** |
| 1 | *Acinetobacter* spp | 26 | 0 | 7 | 16 | 49 |
| 2 | *Burkholderia cepacian* | 1 | 0 | 0 | 0 | 1 |
| 3 | *Candida* spp | 0 | 0 | 0 | 5 | 5 |
| 4 | *Citrobacter* spp | 0 | 1 | 1 | 0 | 2 |
| 5 | *Cryptococcus* | 0 | 0 | 1 | 0 | 1 |
| 6 | *Delftia* spp | 0 | 0 | 0 | 1 | 1 |
| 7 | *Enterobacter aerogenes* | 0 | 0 | 4 | 4 | 8 |
| 8 | *Enterobacter* spp | 2 | 1 | 0 | 0 | 3 |
| 9 | *Enterococcus Faecium* | 0 | 0 | 0 | 2 | 2 |
| 10 | *Enterococcus* spp | 0 | 5 | 2 | 0 | 7 |
| 11 | *Escherichia coli* | 12 | 84 | 16 | 12 | 124 |
| 12 | *Klebsiella pnuemoniae* | 0 | 0 | 10 | 7 | 17 |
| 13 | *Klebsiella* spp | 23 | 15 | 0 | 0 | 38 |
| 14 | *Morganella morgani* | 0 | 1 | 0 | 0 | 1 |
| 15 | *Proteus* spp | 0 | 1 | 0 | 0 | 1 |
| 16 | *Providencia* spp | 0 | 0 | 0 | 1 | 1 |
| 17 | *Pseudomonas aeruginosa* | 21 | 7 | 6 | 5 | 39 |
| 18 | *Salmonella* spp | 0 | 0 | 0 | 12 | 12 |
| 19 | *Serratia marcescens* | 3 | 1 | 0 | 0 | 4 |
| 20 | *Staphylococcus aureus* | 3 | 1 | 13 | 0 | 17 |
| 21 | *Staphyococcus* coagulase negative | 0 | 0 | 0 | 4 | 4 |
| 22 | *Stenotrophomonas maltophila* | 2 | 0 | 0 | 0 | 2 |
| 23 | *Stenotrophomonas* spp | 0 | 0 | 0 | 1 | 1 |
| **Total** | | **93** | **117** | **60** | **70** | **340** |

## 4. DISCUSSION

The burden of antimicrobial resistance is very high in developing countries such as India which is due to the number of factors such as the high burden of disease, poor health setups, insufficient diagnostic support, and lack of data AMR related data that helps in the proper estimation of drug resistance can be accomplished [3, 9]. Due to the difference in geographical as well as climatic conditions in India present study might be shown the different spectrum of bacterial isolates from the western countries [10, 11]. In this study, *E*. *coli* and *P*. *aeruginosa* were found as the predominates bacterial isolates in all types of clinical samples and a similar observation was also reported in several studies [12-15]. According to a governmental ‘scoping report on antimicrobial resistance in India (2017), >70% of isolates of *Acinetobacter baumannii*, *Escherichia coli, Klebsiella pneumoniae*; 50% of all *Pseudomonas aeruginosa* were showed resistance against fluoroquinolones and third-generation cephalosporins while <35% *E. coli* and *P. aeruginosa* exhibited resistance to piperacillin-tazobactum combination. Additionally, an increasing rate of carbapenem resistance was found in 71% of isolates of *A. baumannii* which might be due to the regular use of colistin. Moreover, a total of 42.6% isolates of *Staphylococcus aureus* and 10.5% *Enterococcus faecium* were found resistant to methicillin and vancomycin, respectively. *Salmonella typhi* and *Shigella* species showed a 28 and 82% resistance rate for ciprofloxacin; 0.6 and 12% for ceftriaxone and 2.3 and 80% for co-trimoxazole, respectively. Approximately, 17-75% of *Vibrio cholerae* exhibited resistance to tetracycline in India [5] and approximately 2 million deaths are estimated annually by 2050 [3].

The present study revealed that the aminoglycoside group of antimicrobial agents which contain gentamicin, amikacin, and tobramycin showed sensitivity against *Pseudomonas* spp forms the respiratory sample. A similar observation was also recorded from tertiary care hospitals in India [16, 17]. It also exhibited resistance against *Klebsiella* spp and a similar result was also published for urine samples in India [18]. According to Bashir et al, resistance to aminoglycoside drugs could be an emerging condition for its prescription to Urinary tract infection (UTI) patients [19]. *E*. *coli* and *K*. *pneumoniae* were also exhibite resistance against cephalosporins which correlatedd with the previous study from Tamil Nadu [20]. Further, Multidrug resistance *Salmonell* spp was also found in the present study and a similar result was also published in *S*. *typhi* from India which is also a serious health concern for the treatment of typhoid fever in children [21].

## 5. CONCLUSION

The present study gives a brief highlight on the AMR pattern in the North part of India and also provide insight on the appropriate prescription of antibiotic against pathogenic microorganisms. It finally concluded that the regular susceptibility testing should be conducted with a defined interval to detect the current trend of resistance which helps clinicians in the effective infectious disease management and leads to reducing the burden of AMR. Additionally, a rational approach to drug prescription is urgently required to combat this health concern.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

## REFERENCES

1. Marston HD, Dixon DM, Knisely JM, Palmore TN, Fauci AS. Antimicrobial resistance. Jama. 201;316(11):1193-204.
2. Murray CJ, Ikuta KS, Sharara F, Swetschinski L, Aguilar GR, Gray A, Han C, Bisignano C, Rao P, Wool E, Johnson SC. Global burden of bacterial antimicrobial resistance in 2019: A systematic analysis. The Lancet. 2022 Jan 19.
3. Dixit A, Kumar N, Kumar S, Trigun V. Antimicrobial resistance: Progress in the decade since emergence of New Delhi metallo-β-lactamase in India. Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine. 2019;44(1):4.
4. O’neill J. Antimicrobial resistance. Tackling a crisis for the health and wealth of nations. 2014.
5. Gandra S, Joshi J, Trett A, Lamkang AS, Laxminarayan R. Scoping report on antimicrobial resistance in India. Washington, DC: Center for Disease Dynamics. Economics & Policy. 2017:1-30.
6. MoHFW. National Programme on Containment of Anti-Microbial Resistance (AMR); 2016.
   Available: https://www.nhp.gov.in/national-programme-on-containment-of-anti-

microbial-resistance-(amr)_pg#:~:text=Healthy%20India&text=India%20has%20given%20due%20cognizance,plan%20(2012%2D2017;%20https://www.nature.com/articles/s41598-021-84293-8.pdf
7. Mohammed ZA, Mukhopadhyay C, Varma M, Eshwara VK. Identifying opportunities for antimicrobial stewardship through a point prevalence survey in an Indian tertiary-care teaching hospital. Journal of global antimicrobial resistance. 2020; 23:315-20.
8. Patel JB, Cockerill FR, Bradford PA. Performance standards for antimicrobial susceptibility testing: Twenty- fifth informational supplement.
9. Vaithiyam VS, Rastogi N, Ranjan P, Mahishi N, Kapil A, Dwivedi SN, Soneja M, Wig N, Biswas A. Antimicrobial Resistance Patterns in Clinically Significant Isolates from Medical Wards of a Tertiary Care Hospital in North India. Journal of laboratory Physicians. 2020;12(03):196-202.
10. Schwab F, Gastmeier P, Meyer E. The warmer the weather, the more gram-negative bacteria-impact of temperature on clinical isolates in intensive care units. PloS one. 2014;9(3):e91105.
11. Veeraraghavan B, Jesudason MR, Prakasah JA, Anandan S, Sahni RD, Pragasam AK, Bakthavatchalam YD, Selvakumar RJ, Dhole TN, Rodrigues C, Roy I. Antimicrobial susceptibility profiles of gram-negative bacteria causing infections collected across India during 2014–2016: Study for monitoring antimicrobial resistance trend report. Indian Journal of Medical Microbiology. 2018;36(1):32-6.
12. Gandra S, Tseng KK, Arora A, Bhowmik B, Robinson ML, Panigrahi B, Laxminarayan R, Klein EY. The mortality burden of multidrug-resistant pathogens in India: A retrospective, observational study. Clinical Infectious Diseases. 2019;69(4):563-70.
13. Cilloniz C, Martin-Loeches I, Garcia-Vidal C, San Jose A, Torres A. Microbial etiology of pneumonia: epidemiology, diagnosis and resistance patterns. International Journal of Molecular Sciences. 2016;17(12):2120.
14. Basak S, Singh P, Rajurkar M. Multidrug resistant and extensively drug resistant bacteria: a study. Journal of pathogens. 2016;2016.
15. Mogasale VV, Saldanha P, Pai V, Rekha PD, Mogasale V. A descriptive analysis of antimicrobial resistance patterns of WHO priority pathogens isolated in children from a tertiary care hospital in India. Scientific reports. 2021;11(1):1-7.
16. Javiya VA, Ghatak SB, Patel KR, Patel JA. Antibiotic susceptibility patterns of Pseudomonas aeruginosa at a tertiary care hospital in Gujarat, India. Indian journal of pharmacology. 2008;40(5): 230.
17. Bhat Y R, Lewis LE, KE V. Bacterial isolates of early-onset neonatal sepsis and their antibiotic susceptibility pattern between 1998 and 2004: an audit from a center in India. Italian journal of pediatrics. 2011;37(1):1-6.
18. Saha S, Nayak S, Bhattacharyya I, Saha S, Mandal A, Chakraborty S, Bhattacharyya R, Chakraborty R, Franco OL, Mandal SM, Basak A. Understanding the patterns of antibiotic susceptibility of bacteria causing urinary tract infection in West Bengal, India. Frontiers in microbiology. 2014;5:463.
19. Mir AR, Bashir Y, Dar FA, Sekhar M. Identification of genes coding aminoglycoside modifying enzymes in E. coli of UTI patients in India. The Scientific World Journal. 2016;2016.
20. Padmini N, Ajilda AA, Sivakumar N, Selvakumar G. Extended spectrum β- lactamase producing Escherichia coli and Klebsiella pneumoniae: critical tools for antibiotic resistance pattern. Journal of Basic Microbiology. 2017;57(6):460-70.
21. Chandane P, Gandhi A, Bowalekar S. Study of antibiotic susceptibility pattern of Salmonella typhi in children suffering from enteric fever. Annals of Tropical Medicine & Public Health. 2017;10(2).



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