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Antimicrobial Sensitivity Pattern Analysis of Bacterial Species Isolated from Urine Samples

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ABSTRACT

Background: Antimicrobial resistance is a significant global health issue. In order to apply efficient control measures to stop the rapid spread of drug resistance, it is vital to comprehend the sensitivity pattern of antibiotics in various types of therapeutically relevant samples.

Objective: The present study was carried out to evaluate the distribution of microbial isolates in urine samples and antimicrobial sensitivity in an Indian healthcare setting.

Materials and methods: The urine samples were collected from the both outpatient Department (OPD) and the inpatient department (IPD) between January to June 2023 and transferred to the microbiology laboratory for further investigation. All samples were analysed in specific culture media and pure bacterial isolates were subjected for the evaluation of antimicrobial sensitivity of a range of antimicrobial drugs.

Results: A total of 6732 samples were collected and processed out of which only 918 (14%) samples were found positive for microbial growth. In positive samples, a total of 84% of samples were collected from IPD while the rest were collected from the OPD of different departments. In urine samples, Escherichia coli was found as the predominated microbial isolates. The antimicrobial sensitivity pattern analysis of urine samples revealed that E. coli has high sensitivity against amikacin and Klebsiella spp. have maximum sensitivity against nitrofurantoin, Pseudomonas spp. have good sensitivity against piperacillin/tazobactam and Candida spp. has sensitivity against flucytosine.

Conclusion: The present study concluded that urine samples have similar microbial patterns in IPD and OPD settings and suggest the best antimicrobial drug to improve treatment modalities in a specific geographical region.

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Introduction

Antimicrobial drugs have been the sole simple and widely available therapeutic option for diseases caused by various microbial pathogens. However, microbial populations have developed resistance to combat antimicrobial drugs- a key contributing factor in the development of anti-microbial resistance (AMR) [1]. According to the World Health Organisation (WHO), AMR is caused by mutations in bacteria, which renders antimicrobial drugs ineffective and illnesses persist in the body, increasing the risk of dissemination to others [2]. In 2019, a total of 4.95 million deaths were documented due to AMR, with 1.27 million deaths occurring due to bacterial AMR globally [3] and it is expected to reach up to 10 million deaths per year by 2050 [4]. India holds the first position in the world in antibiotic consumption for human use [5]. Since then, the pace of consumption is expected to rise. The medical practitioners were found to have inadequate information regarding the proper usage of antibiotics, especially fixed-drug combinations, and the widespread availability of illegal antimicrobials demonstrates a deficiency in the functioning of health authorities [6]. Other factors such as the heavy burden of disease, poor infrastructure, rising incomes, and uncontrolled sales of antibiotics, have augmented the crisis of AMR in India [7].

The age-standardized infectious illness mortality rates in India are among the highest in South Asia, and the levels of antibiotic resistance are concerning [8]. For example, the resistance to widely used wide-spectrum fluoroquinolone antibiotics and third-generation cephalosporins is widespread; studies have shown that >70% of Acinetobacter baumannii, Escherichia coli, and Klebsiella pneumoniae isolates, as well as >50% of Pseudomonas aeruginosa isolates, are resistant to third-generation cephalosporins and fluoroquinolones [9-10]. The advent of new AMR mechanisms, such as New Delhi metallo--lactamase (NDM-1) in 2008, and its rapid global spread to over 70 nations, necessitates immediate action: The blaNDM-1 gene encodes a carbapenemase capable of neutralising the most potent and effective carbapenem antibiotics [4].

To address this significant concern, it is necessary to understand the sensitivity pattern of antibiotics in different types of clinically

relevant samples for the implementation of effective control measures to prevent the rapid spread of drug resistance. However, the Ministry of Health and Family Welfare formed three technical committees, namely the Intersectoral Coordination Committee, Technical Advisory Group, and Core Working Group on AMR, to create a National Action Plan on AMR (NAP-AMR). The Antimicrobial Resistance Surveillance Network (AMRSN) was established by the Indian Council of Medical Research (ICMR). Only five large hospitals in India are included in this surveillance network, which is insufficient to give detailed insight into the actual status of AMR among hospitalised patients. The facts and numbers shown above emphasise the critical need to monitor and handle the AMR problem [5].

Aims of the Study

The present study was carried out to find the pattern of microbial growth in hospital settings, and their antimicrobial sensitivity pattern to provide a detailed insight that helps in the development of new guidelines for better utilization of antimicrobial therapy to combat the concern of AMR.

Materials and Methods

In this study, urine samples were collected from the both outpatient department (OPD) and the inpatient department (IPD) and evaluated for their sensitivity pattern from January to June 2023 from SSB heart and multispeciality hospital-Faridabad. Moreover, all samples were analysed in specific culture media by following standard operating procedures to develop an antibiogram. Then pure bacterial isolates were subjected to evaluation by vitek 2) and interpretation was made on the basis of guidelines published by the Clinical and Laboratory Standards Institute [11]. Antimicrobial drugs such as amikacin, amoxyclav, cefixime, ceftazidime, ceftriaxone, ciprofloxacin, ertapenem, fosfomycin, gentamycin, imipenem, nalidixic acid, nitrofurantoin, norfloxacin, ofloxacine piptazobactam, tigecycline, trimethoprim/sulbactam were compared to evaluate sensitivity status.

Results

During the study tenure, 6732 samples (Figure 1) were collected and processed, of which only 918 (14%) samples were found positive for microbial growth. In positive samples, a total of 84% of samples were collected from IPD while the rest were collected from the OPD of different departments (Figure 2).

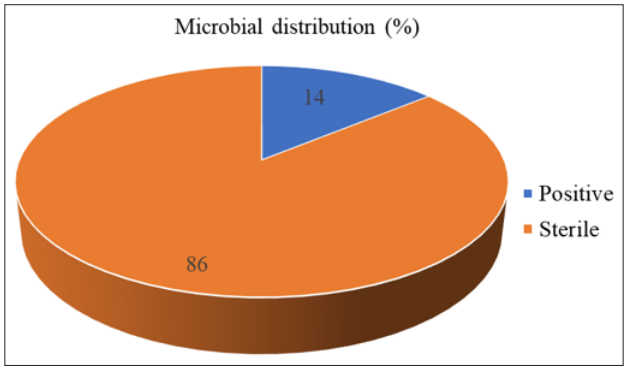

Figure 1: Samples Collected During Study Period

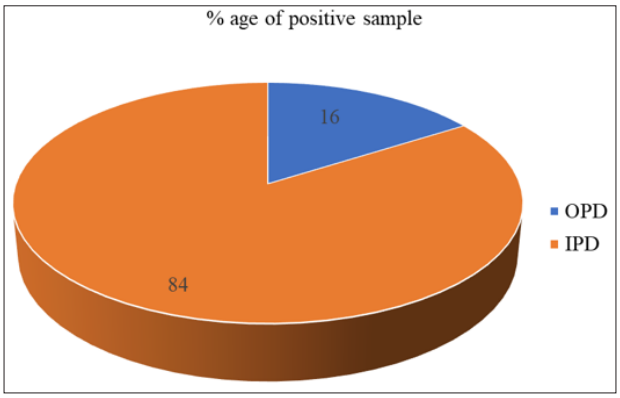

Figure 2: Positive Sample Percentage in OPD and IPD Samples

Urine samples from IPD had higher microbial proportion as compared to the OPD (figure 3).

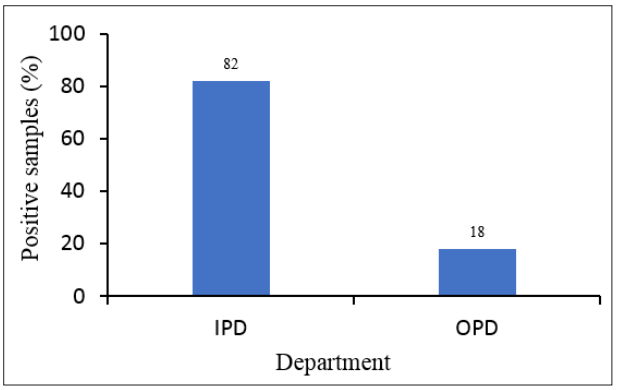

Figure 3: Percentage of Microbial Isolate in Urine Samples from OPD and IPD

Further, descriptive analysis for the dominant microbial isolates was also carried out in both IPD as well as OPD samples.

Urine Analysis

In urine samples, Escherichia coli was found the dominant bacterial isolate followed by Klebsiella spp. and Pseudomonas spp. in both IPD and OPD samples. Further, no Candida spp. was recorded in the OPD sample while only 8% of samples had Candida spp. (Figure 4). Moreover, most of the drugs showed similar sensitivity patterns against E. coli in IPD samples while in OPD urine isolates amikacin, nitrofurantoin, fosfomycin, gentamycin, amoxyclave showed good sensitivity patterns against E. coli while the rest of the antibacterial drugs found to have resistance against all isolates (Figure 5).

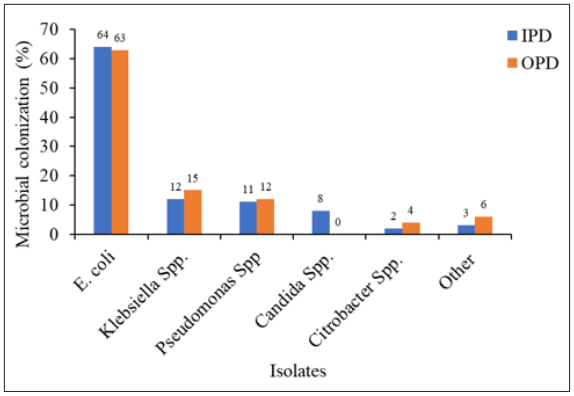

Figure 4: Microbial Colonisation Pattern in Urine Samples from IPD and OPD

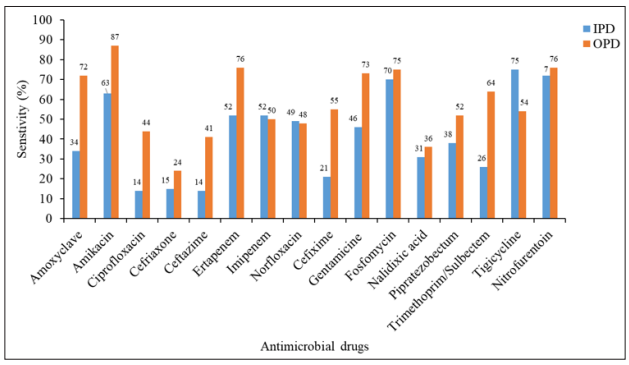

Figure 5: Antibacterial Sensitivity Analysis of E. coli from IPD and OPD Urine Samples

In case of Klebsilla spp. from urine samples, all drugs were found to have less than 50% sensitivity in IPD samples while Klebsilla spp. form OPD samples had good sensitivity pattern out of which maximum sensitivity was recorded in nitrofurantoin and fosfomycin i.e., 70% for each. Moreover, a total of 60% sensitivity was recorded for amikacin, imipenem and tigicycline (Figure 6).

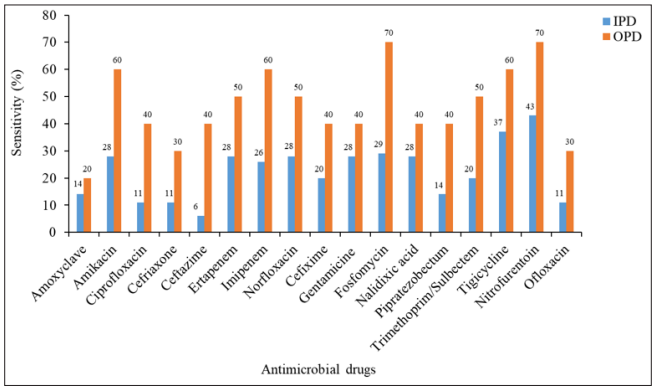

Figure 6: Antibacterial Sensitivity for Klebsilla spp. Isolated from IPD and OPD Urine Samples

In the case of Pseudomonas spp., IPD isolates showed less sensitivity for all drugs than OPD isolates. OPD isolates found to have good sensitivity for piperacillin/tazobactam, gentamycin, Imipenem, meropenem, trimethoprim/sulbectem. Moreover, colistin showed no sensitivity in both IPD and OPD samples (Figure 7).

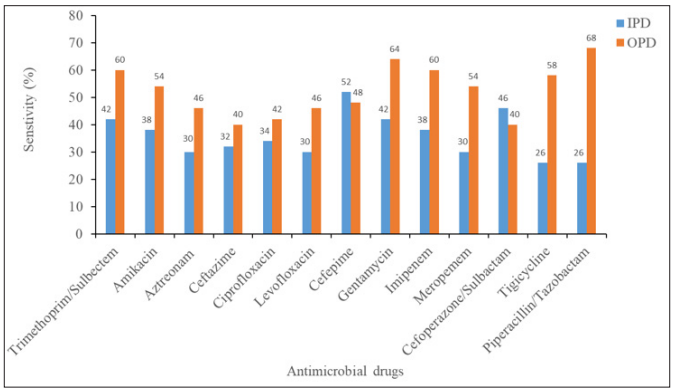

Figure 7: Antibacterial Sensitivity for Pseudomonas spp. Isolated from IPD and OPD Urine Samples

Candida spp: showed maximum sensitivity against flucytocin (74), followed by voriconazole, fluconazole i.e., 70 and 65%, respectively (Figure 8).

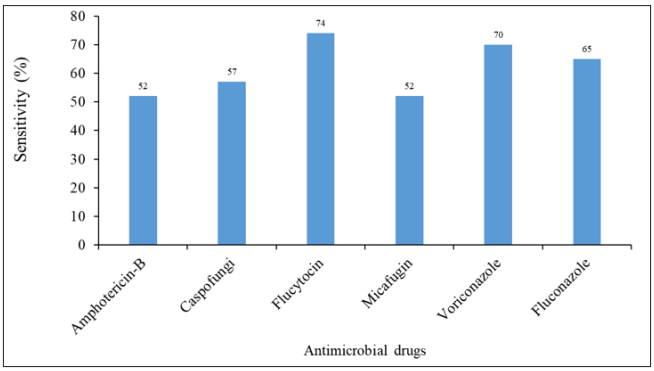

Figure 8: Antibacterial Sensitivity Pattern of Candida spp

Discussion

The pattern of resistance of antimicrobial drugs against urinary tract microbial isolates has become a serious concern throughout the world. This might be due to the fact that the antimicrobial treatment against urinary tract infection (UTI) starts before the identification of particular microorganisms; this practice promotes antibiotic resistance. Hence, it is necessary to evaluate the status of antimicrobial resistance regularly which helps in the improvement of treatment modalities against urinary tract infections [12]. This study focused on the pattern of uropathogenic microorganisms which is very common in both IPD and OPD settings in India. The present study revealed that the prevalence of E. coli was found the dominant bacterial isolate and a similar pattern was also reported in India [13], Iraq [14] the USA [15] and Iran [16, 17]. In vitro, antibiotic sensitivity pattern analysis observed that E. coli has high sensitivity against amikacin and a similar observation was also documented from tertiary care settings in India [18] and the USA [19].

The present study revealed that Klebsiella spp. was the second dominant isolate from urine samples and this was also favoured by several studies in India [20-22]. In antimicrobial sensitivity analysis, it was recorded that Klebsiella spp. has maximum sensitivity against nitrofurantoin and fosfomycin. The susceptibility of Klebsiella isolates to nitrofurantoin was also recorded in studies across India [20. 21]. In the case of Pseudomonas spp., IPD isolates showed less sensitivity for all drugs than OPD isolates. Piperacillin/tazobactam was found to have good sensitivity against Pseudomonas spp. According to Pokharel et al, piperacillin/tazobactam is one of the good choices for the treatment of Pseudomonas spp. infections [23-25]. In this study, only Candida spp. were isolated from IPD samples which exhibited maximum sensitivity against Candida spp. showed maximum sensitivity against flucytocin and a similar observation was also reported from Tehran [26].

Conclusion

The present study concluded that the urine samples have similar microbial profiles in IPD and OPD settings. It also provides insight into the laboratory information to evaluate antimicrobial drug sensitivity and suggests the best antimicrobial drug to improve treatment strategies in a specific geographical region. The study also allows a comparison of antimicrobial patterns in other regions of India.

Authors' Contributions: The authors contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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References

1. Anil C, Shahid RM (2013) Antimicrobial susceptibility patterns of Pseudomonas aeruginosa clinical isolates at a tertiary care hospital in Kathmandu, Nepal. Asian J Pharm Clin Res 6: 235-238.
2. WHO. Antimicrobial resistance2018. https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance. Accessed 11 Sep 2023.
3. Murray CJ, Ikuta KS, Sharara F, Swetschinski L, Aguilar GR, et al. (2022) Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. The Lancet 399: 629-655.
4. Dixit A, Kumar N, Kumar S, Trigun V (2019) Antimicrobial resistance: Progress in the decade since emergence of New Delhi metallo-β-lactamase in India. Indian journal of community medicine 44: 4-8.
5. Van Boeckel TP, Gandra S, Ashok A, Caudron Q, Grenfell BT, et al. (2014) Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. The Lancet infectious diseases 14: 742-50.
6. Taneja N, Sharma M.(2019)Antimicrobial resistance in the environment: The Indian scenario. The Indian journal of medical research. 149:119-128
7. Ganguly NK, Arora NK, Chandy SJ, Mohamed Nadeem Fairoze, J P S Gill et al (2011) Global Antibiotic Resistance Partnership (GARP) - India Working Group. Rationalizing antibiotic use to limit antibiotic resistance in India. Indian J Med Res.358:281-294
8. Hsu LY, Apisarnthanarak A, Khan E, Suwantarat N, Ghafur A (2017)Tambyah PA. Carbapenem-resistant Acinetobacter baumannii and Enterobacteriaceae in south and southeast Asia. Clinical microbiology reviews.30:1-22.
9. Gandra S, Joshi J, Trett A, Lamkang AS, Laxminarayan R.(2017) Scoping report on antimicrobial resistance in India. Center for Disease Dynamics, Economics & Policy: Washington,DC,USA.:1-146.
10. Nair M, Zeegers MP, Varghese GM, Burza S (2021) India's National Action Plan on Antimicrobial Resistance: a critical perspective. Journal of Global Antimicrobial Resistance.27:236-238.
11. Patel JB (2015) Performance standards for antimicrobial susceptibility testing; twenty-fifth informational supplement 35.
12. Kashef N, Djavid GE, Shahbazi S, (2010) The Journal of Infection in Developing Countries. 4: 202-206.
13. Subramanian M, Ganesapandian S, Singh M, Kumaraguru A, (2011) Antimicrobial susceptibility pattern of urinary tract infection causing human pathogenic bacteria. Asian J Med Sci 3: 56-60.
14. Al-Naqshbandi AA, Chawsheen MA, Abdulqader HH, (2019) Prevalence and antimicrobial susceptibility of bacterial pathogens isolated from urine specimens received in rizgary hospital—Erbil. Journal of infection and public health 12: 330-336.
15. Das R, Perrelli E, Towle V, Van Ness PH, Juthani-Mehta M, (2019) Antimicrobial susceptibility of bacteria isolated from urine samples obtained from nursing home residents. Infection Control & Hospital Epidemiology 30: 1116-1119.