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Original research article

EVALUATION OF ANTIBIOTIC RESISTANCE PATTERNS IN PRIMARY HEALTHCARE SETTINGS

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Abstract: *Antibiotic resistance has emerged as one of the most significant public health challenges of the 21st century, posing serious threats to the effectiveness of treatments for infectious diseases.* ***Objective:*** *The main objective of this study is to identify antibiotic resistance patterns in primary healthcare settings.* ***Methods:*** *This cross-sectional study was conducted at Sehat Hospital Hyderabad from June 2022 to June 2023. Data were collected from 650 participants who sought medical care for bacterial infections and had been prescribed antibiotics in the primary healthcare setting. Participants who consented to the study and agreed to provide necessary samples for analysis were included. Demographic information, history, and clinical examinations were collected using systematically designed questionnaires and chart abstractions. Statistical analysis was performed using appropriate methods, with a p-value of <0.05 considered statistically significant.* ***Results:*** *Data were collected from 650 participants with a mean age of 38.09 ± 9.81 years. Of these, 52% were female and 48% were male. Respiratory infections were the most common, affecting 35% of participants. Recent antibiotic use was significantly associated with higher resistance rates, with 45% resistance in those who had used antibiotics recently compared to 20% in those who had not ($p < 0.01$). Participants aged 60 years and older exhibited a higher resistance rate of 35% compared to 20% in those under 60 years old ($p < 0.05$). Gender did not show a significant association with antibiotic resistance, with resistance rates of 25% in females and 27% in males ($p = 0.65$).* ***Conclusion:*** *Antibiotic resistance poses a significant threat in primary healthcare settings, with a high prevalence of resistant and multi-drug-resistant strains identified.*

Keywords: Anti-Bacterial Agents, Antibiotic Resistance, Cross-Sectional Studies, Primary Health Care, Respiratory Tract Infections, Risk Factors

Introduction

Antibiotic resistance has emerged as one of the most significant public health challenges of the 21st century, posing serious threats to the effectiveness of treatments for infectious diseases. This phenomenon occurs when bacteria evolve mechanisms to withstand the drugs that once eradicated them, leading to prolonged illnesses, increased healthcare costs, and a higher risk of mortality (1). Primary healthcare settings, which serve as the first point of contact for patients, play a crucial role in the administration of antibiotics and the management of infections. Consequently, these settings are pivotal in both the emergence and containment of antibiotic resistance. Right now, everyone is aware of a pandemic of disease which has emerged with antibiotic resistance and travelling across the globe (2).

As stated by WHO, the usage of antibiotics in the first level of care facilities equals 80% of all utilized doses. With the degradation of bacteria through antibiotics, there is always the possibility of developing antibiotic resistance such as through the use of broad-spectrum antibiotics in cases of bacterial infections like acute respiratory tract infections treated with antibiotics (3). Mistrustful use of antibiotics by health care workers in the prescription of the drug in primary care clinics also played an essential role in antibiotic resistance. The number of antibodies which can be prescribed might be multiple or less in one particular medical practice when compared to others and there is ample evidence that shows that Primary care physicians located in different geographic areas have different rates for the prescription of antibiotics (4). Antibiotics are fundamental drugs that have eliminated many diseases caused by bacteria in the world over many years. These medications are usually utilized with the intent of eradicating the disease-causing microorganisms or preventing them from multiplying (5).

They are prescribing more today in hospitals than any other drugs in the world. People need to maintain health and fight various infections, and antibiotics are effective in preventing infectious diseases, particularly in the so-called 'third world countries." On the other hand, cases of unsuitable prescriptions involve a higher propensity to help create an environment where resistant bacteria emerge and affect treatment methodologies (6, 7). Antibiotic resistance is the scenario whereby some dangerous bacteria become capable in some way or manner that reduces or even

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prevents the efficiency of the antibiotic. Even though antibiotic resistance is an infrequent issue, it is increasingly observed due to misuse or appropriate prescriptions of antibiotics (8-10). It has now or sooner or later been discovered all over the world and is now ranked as the most severe threat to the well-being of the people of the whole world. These days, drug resistance has been one of the largest threats, which emerged within the last few decades (11). Therefore, the main objective of the study is to find the antibiotic resistance Patterns in Primary healthcare settings.

Methodology

This cross-sectional study design was conducted at Sehat Hospital Hyderabad from June 2022 to June 2023. Data were collected from 650 participants for this study. All patients who sought medical care for bacterial infections, individuals who had been prescribed antibiotics in the primary healthcare setting, and patients who consented to participate in the study and agreed to provide necessary samples for analysis were included in the study. For the demographic information, history, and clinical examinations, there were systematically designed questionnaires and chart abstractions. Even minor details like the type of infection, the symptoms, and past experiences with the use of antibiotics were not overlooked in the documentation. Blood, urine and swabs from sites of infected tissue were then taken from subjects with suspected bacterial infection. All the collected samples were quickly transported to the clinical microbiology laboratory for analysis. The stages involved in the identification of bacterial pathogens included bacterial culturing of the samples in the appropriate media. The identification of each bacterial isolate was done by several biochemical tests wherein molecular identification was used only as a confirmatory tool when necessary. After isolation and identification of organisms, susceptibility testing for antibiotics was done by Kirby Bauer disk diffusion technique. These tests involved several antibiotics frequently used by general practitioners for the treatment of diseases presented at the first levels of care. From these tests, the outcome was assessed by using the protocols provided by the Clinical and Laboratory Standards Institute (CLSI). Among those reported, most of the documented resistance patterns targeted primarily the rate of multi-drug resistant (MDR) strains, which were essential information of primary antimicrobial resistance. Data were then analyzed using SPSS v29. All the variables are presented as mean and SD.

Results

Data were collected from 650 participants. The mean age of the participants was 38.09±9.81 years. Out of 650, there were 52% female and 48% male patients. Most of the patients suffered from respiratory infection which was 35%. (Table 1)

Table 1: Demographic data of participants

Characteristic	Value
Total Participants	650
Age (years)	38.09±9.81
Gender	
- Female	52% (338)
- Male	48% (312)
Type of Infection	
- Respiratory	35% (228)
- Urinary Tract Infection (UTI)	25% (163)
- Skin and Soft Tissue	20% (130)
- Gastrointestinal	10% (65)
- Other	10% (65)

720 bacterial isolates, with Escherichia coli being the most prevalent species, accounting for 30% (216 isolates). Staphylococcus aureus represented 20% (144 isolates), followed by Streptococcus pneumoniae at 15% (108 isolates). Klebsiella pneumonia and Pseudomonas aeruginosa comprised 10% (72 isolates) and 8% (58 isolates) of the total, respectively. Other bacterial species made up the remaining 17% (122 isolates), highlighting a diverse range of pathogens contributing to infections in primary healthcare settings. (Table 2)

Table 2: Distribution of Bacterial Isolates

Bacterial Species	Percentage of Isolates	Number of Isolates
Escherichia coli	30%	216
Staphylococcus aureus	20%	144
Streptococcus pneumoniae	15%	108
Klebsiella pneumoniae	10%	72
Pseudomonas aeruginosa	8%	58
Other	17%	122
Total	**100%**	**720**

Escherichia coli showed high resistance to ampicillin (60%), ciprofloxacin (40%), and trimethoprim-sulfamethoxazole (25%). Staphylococcus aureus had a 30% resistance rate to methicillin (MRSA), with 20% resistance to clindamycin and 15% to tetracycline. Streptococcus pneumoniae exhibited 25% resistance to penicillin and 10%

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to erythromycin. Klebsiella pneumoniae showed resistance rates of 35% to ceftriaxone, 30% to ciprofloxacin, and 20% to gentamicin. Pseudomonas aeruginosa had resistance rates of 20% to piperacillin-tazobactam, 15% to ceftazidime, and 10% to ciprofloxacin. These patterns underscore the widespread and variable resistance among common pathogens in primary healthcare settings. (Table 3)

Table 3: Antibiotic Resistance Patterns

Bacterial Species	Antibiotic	Resistance Percentage
Escherichia coli	Ampicillin	60%
	Ciprofloxacin	40%
	Trimethoprim-Sulfamethoxazole	25%
Staphylococcus aureus	Methicillin (MRSA)	30%
	Clindamycin	20%
	Tetracycline	15%
Streptococcus pneumoniae	Penicillin	25%
	Erythromycin	10%
Klebsiella pneumoniae	Ceftriaxone	35%
	Ciprofloxacin	30%
	Gentamicin	20%
Pseudomonas aeruginosa	Piperacillin-Tazobactam	20%
	Ceftazidime	15%
	Ciprofloxacin	10%

Table 4 shows the prevalence of multi-drug resistant (MDR) strains among various bacterial species. Escherichia coli exhibits the highest MDR prevalence at 30%, followed by Staphylococcus aureus (MRSA) at 20%, Klebsiella pneumoniae at 15%, and Pseudomonas aeruginosa at 10%. The overall prevalence of MDR strains in the studied population is 25%.

Table 4: Prevalence of Multi-Drug Resistant (MDR) Strains

Bacterial Species	Percentage of MDR Strains
Escherichia coli	30%
Staphylococcus aureus (MRSA)	20%
Klebsiella pneumoniae	15%
Pseudomonas aeruginosa	10%
Overall MDR Prevalence	**25%**

Recent antibiotic use was significantly associated with a higher resistance percentage, with those reporting antibiotic use showing a resistance rate of 45%, compared to 20% in those who did not use antibiotics recently ($p < 0.01$). Additionally, participants aged 60 years and older exhibited a higher resistance rate of 35% compared to 20% in those under 60 years old ($p < 0.05$). However, gender did not show a significant association with antibiotic resistance, with resistance rates of 25% in females and 27% in males ($p = 0.65$). (Table 5)

Table 5: Factors Associated with Antibiotic Resistance

Factor	Resistance Percentage	P-value
Recent Antibiotic Use		<0.01
- Yes	45%	
- No	20%	
Age Group		<0.05
- <60 years	20%	
- ≥60 years	35%	
Gender		0.65
- Female	25%	
- Male	27%	

The odds ratio (OR) for recent antibiotic use was 2.5 (95% CI: 1.8 - 3.4), indicating that participants with recent antibiotic use were 2.5 times more likely to encounter antibiotic-resistant bacteria compared to those who did not use antibiotics recently. Similarly, for participants aged 60 years and older, the odds ratio was 1.7 (95% CI: 1.2 - 2.5). (Table 6)

Table 6: Multivariate Logistic Regression Analysis of Predictors of Antibiotic Resistance

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)
Recent Antibiotic Use	2.5	1.8 - 3.4
Age ≥60 years	1.7	1.2 - 2.5

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Discussion

The study identified a significant prevalence of antibiotic-resistant bacteria, with multi-drug resistant (MDR) strains constituting 25% of the isolates. Escherichia coli was the most frequently isolated bacterium (n = 30) and was observed to be highly resistant to ampicillin – 60%, and ciprofloxacin 40%. The percentage of specimens which yielded MRSA was 30% and this demonstrated the difficulties in the management of infections caused by this pathogen in the primary healthcare sector (11, 12). Research results also revealed that the recent use of antibiotics and the older age of patients were significantly associated with antibiotic resistance. The individuals who had taken antibiotics in the previous year were at 2. 5 times higher risk of carrying the resistant bacteria compared to those who had never used antibiotics (OR = 2. 5, 95% CI = 1. 8-3. 4) emphasizing excessive and irrational use of antibiotics as one of the main drivers to resistant bacteria (13). This is to the existing literature where it is recommended that the use of antibiotics, particularly where resistant organisms are prevalent, should be reasonable to minimize the overgrowth of resistant strains. Similarly, older age, defined as aged 60 years and above, was also independently related to the risk of exposure to resistant bacteria (OR = 1. 7, 95% CI 1. 2-2. 5). This could be attributed to several reasons such as the fact that older adults are more prone to have other diseases which in turn exposes them to many health checks; older adults have been known to visit many clinics which exposes them to many different antibiotics and therefore, are more likely to have more antibiotic-resistant bacteria (14). Based on the information obtained from these two scientific pieces, it might be advisable to recommend that approaches like focusing on older patients and prescribing specific antibiotics should be adopted to reduce resistance. It is believed that antibiotic resistance is brought under control if the antibiotics are appropriately prescribed and administered and; rational antibiotic use implies practical antibiotic use (15). This is regarded as rational utilisation of medication when patients acquire necessary drugs; in requisite quantity for the disease type and stage; in right proportion with their ailment; and at the most minimal possible price. Manne, et al., and Queder, et al. conducted studies analyzing factors that general practitioners' prescribers antibiotics in particular settings (16). By using the proposed theoretical framework and assessing physicians' contextual characteristics at the individual practice and systemic levels in these practices, these findings suggested that antibiotic prescribing is a function of contextual factors at the individual practice and systemic levels (17). However, the authors want the reader to understand that these results could not be specific to other counties that are outside the study area in the case of the healthcare systems of specialised laboratories. To provide improvement in prescribing interventions, the cause of variation should be known (18).

Conclusion

Antibiotic resistance poses a significant threat in primary healthcare settings, with a high prevalence of resistant and multi-drug resistant strains identified. Key risk factors include recent antibiotic use and older age, underscoring the need for robust antibiotic stewardship programs. Implementing targeted interventions and ongoing surveillance is crucial to mitigating this growing public health challenge.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate.
Approved by the department Concerned. (IRB/SHHBD-s034 dated 14-02-22)
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Conflict of interest

The authors declared an absence of conflict of interest.

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References

1. Tseng Y-W, Huang C-W, Chen C-C, Er T-K. Assessment of antibiotic resistance patterns in Central Taiwan during the COVID-19 pandemic: A retrospective study. Journal of Infection and Public Health. 2024;17(2):229-35.
2. Giacomini E, Perrone V, Alessandrini D, Paoli D, Nappi C, Degli Esposti L. Evidence of antibiotic resistance from population-based studies: A narrative review. Infection and drug resistance. 2021:849-58.
3. Huang Y-WY, Alleyne A, Leung V, Chapman M. Urosepsis due to extended-spectrum β-lactamase–producing Escherichia coli: a retrospective, single-centre review of risk factors and clinical outcomes. The Canadian Journal of Hospital Pharmacy. 2018;71(2):119.
4. Silva ACB, Anchieta LM, Lopes MFdP, Romanelli RMdC. Inadequate use of antibiotics and increase in neonatal sepsis caused by resistant bacteria related to health care assistance: a systematic review. Brazilian Journal of Infectious Diseases. 2018;22:328-37.
5. Bartoletti M, Giannella M, Lewis R, Caraceni P, Tedeschi S, Paul M, et al. A prospective multicentre study of the epidemiology and outcomes of bloodstream infection in cirrhotic patients. Clinical Microbiology and Infection. 2018;24(5):546. e1-. e8.

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6. Leal JR, Conly J, Henderson EA, Manns BJ. How externalities impact an evaluation of strategies to prevent antimicrobial resistance in health care organizations. Antimicrobial Resistance & Infection Control. 2017;6:1-11.
7. Huebner C, Flessa S, Huebner N. The economic impact of antimicrobial stewardship programmes in hospitals: a systematic literature review. Journal of Hospital Infection. 2019;102(4):369-76.
8. Birgand G, Castro-Sánchez E, Hansen S, Gastmeier P, Lucet J-C, Ferlie E, et al. Comparison of governance approaches for the control of antimicrobial resistance: analysis of three European countries. Antimicrobial Resistance & Infection Control. 2018;7:1-12.
9. Han H-S, Park DJ. Antibiotic prophylaxis and surgical site infection prevention. Enhanced Recovery After Surgery: A Complete Guide to Optimizing Outcomes. 2020:259-67.
10. Allegranzi B, Zayed B, Bischoff P, Kubilay NZ, de Jonge S, de Vries F, et al. New WHO recommendations on intraoperative and postoperative measures for surgical site infection prevention: an evidence-based global perspective. The Lancet Infectious Diseases. 2016;16(12):e288-e303.
11. Wald-Dickler N, Spellberg B. Short-course antibiotic therapy—replacing constantine units with "shorter is better". Oxford University Press US; 2019. p. 1476-9.
12. Aslam A, Gajdács M, Zin CS, Binti Abd Rahman NS, Ahmed SI, Jamshed SQ. Public awareness and practices towards self-medication with antibiotics among the Malaysian population. A development of questionnaire and pilot-testing. Antibiotics. 2020;9(2):97.
13. Shekhawat NS, Shtein RM, Blachley TS, Stein JD. Antibiotic prescription fills for acute conjunctivitis among enrollees in a large United States managed care network. Ophthalmology. 2017;124(8):1099-107.
14. Smieszek T, Pouwels KB, Dolk FCK, Smith DR, Hopkins S, Sharland M, et al. Potential for reducing inappropriate antibiotic prescribing in English primary care. Journal of Antimicrobial Chemotherapy. 2018;73(suppl_2):ii36-ii43.
15. Tadesse TY, Molla M, Yimer YS, Tarekegn BS, Kefale B. Evaluation of antibiotic prescribing patterns among inpatients using World Health Organization indicators: A cross-sectional study. SAGE Open Medicine. 2022;10:20503121221096608.
16. Kasse GE, Humphries J, Cosh SM, Islam MS. Factors contributing to the variation in antibiotic prescribing among primary health care physicians: a systematic review. BMC Primary Care. 2024;25(1):8.
17. Okubo Y, Nishi A, Michels KB, Nariai H, Kim-Farley RJ, Arah OA, et al. The consequence of financial incentives for not prescribing antibiotics: a Japan's nationwide quasi-experiment. International journal of epidemiology. 2022;51(5):1645-55.
18. Wojcik G, Ring N, McCulloch C, Willis DS, Williams B, Kydonaki K. Understanding the complexities of antibiotic prescribing behaviour in acute hospitals: a systematic review and meta-ethnography. Archives of Public Health. 2021;79:1-19.

[Citation: HAKIMI, M., MAHESSAR, S.S., ULLAH, Q., BHATTY, E.T., ILYAS, A., SHAHID, S., ASIM, F., (2024). Evaluation of antibiotic resistance patterns in primary healthcare settings. *Biol. Clin. Sci. Res. J.*, **2024***: 902*. doi: https://doi.org/10.54112/bcsrj.v2024i1.902]