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Original Research Article

Antibiotic Susceptibility Patterns of Bacterial Isolates from Pus Samples in a Tertiary Care Centre of Patna, India

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Abstract

Background: The development of antibiotic resistance is a problem that affects people all across the world, including India. This study's objective was to determine the antibiotic resistance profiles of bacterial isolates obtained from pus samples gathered at a tertiary care centre in Patna, India.

Methodology: Between April 2022 and March 2023, pus samples were taken from 250 patients for this cross-sectional investigation. The Kirby-Bauer disc diffusion method was used to determine antibiotic susceptibility after bacterial isolates were identified using normal microbiological procedures.

Results: The most commonly found bacteria were Staphylococcus aureus, Klebsiella pneumoniae, and E. coli. Most bacterial isolates tested positive for resistance to at least one antibiotic, with ampicillin, ciprofloxacin, and cotrimoxazole showing the highest rates of resistance. Antibiotic susceptibility profiles varied greatly amongst bacterial species.

Conclusion: Bacterial isolates from pus samples were shown to have a significant prevalence of antibiotic resistance in this investigation from a tertiary care centre in Patna, India. To enhance patient outcomes and forestall the formation and spread of antibiotic-resistant organisms, these results highlight the importance of robust antimicrobial stewardship programmes and focused treatment guidelines. Antibiotic resistance is a serious problem, and more study is needed to determine its causes and provide viable solutions.

Categories: Healthcare Technology

Keywords: Antibiotic Resistance, Bacterial Isolates, Kirby-Bauer Disc Diffusion Method, Antibiotic Susceptibility Patterns.

Introduction

Antibiotic resistance has become a serious global health problem, especially in underdeveloped nations like India where the drug is overprescribed without adequate patient diagnosis and follow-up [1]. Since multidrug-resistant bacterial strains have developed due to antibiotic overuse and misuse, treating bacterial infections has become increasingly challenging [2]. The World Health Organisation found that India

has one of the highest rates of antibiotic resistance globally. Monitoring antibiotic susceptibility patterns of bacteria isolated from clinical samples is crucial for addressing this rising issue. Patients with skin and soft tissue infections have their pus sampled frequently since it is such a valuable indicator of the local prevalence of antibiotic-resistant bacteria [3]. The purpose of this investigation was to identify antibiotic resistance profiles among bacterial isolates from pus samples collected in a tertiary care facility in Patna, India. The results of this study will aid in the establishment of effective treatment protocols for bacterial infections in Patna by providing important data on the prevalence and distribution of antibiotic-resistant bacteria in the city. The findings of this study can also be utilised to educate medical professionals and the public about the value of antibiotic stewardship.

Background and Rationale for the Study

As a primary cause of illness and death in many nations, antibiotic resistance has emerged as a pressing public health issue around the world. The overuse and misuse of antibiotics, lack of sufficient infection control methods, and poor sanitation and hygiene all contribute to the severity of the problem in India. Antibiotic resistance is facilitated by the broad availability of over-the-counter medications and the practise of self-medication. In immunocompromised patients, skin and soft tissue infections among the most common bacterial infections seen in clinical practice are a major source of morbidity and mortality. Treatment failure, longer hospital stays, and higher healthcare expenses can result from using the wrong medicines or waiting too long to treat certain illnesses. Unfortunately, the development of multidrug-resistant bacterial species has complicated the process of choosing effective medicines.

Antibiotics are often used for treatment in Patna, India, using an empirical approach where the most likely bacterial infections are considered. Even in the absence of antibiotic resistance, however, empirical therapy has its limitations. That's why it's so important to keep an eye on the antibiotic resistance profiles of bacteria isolated from clinical samples. The purpose of this investigation was to identify antibiotic resistance profiles among bacterial isolates from pus samples collected in a tertiary care facility in Patna, India. In order to guide the selection of appropriate antibiotics for the treatment of bacterial infections in the region, it is crucial to first determine the prevalent bacterial species and the extent to which they have developed resistance to antibiotics. Clinicians and public health officials in Patna, India can use the study's findings to better treat bacterial infections and create better regulations.

Scope and Limitations of the Study

Bacterial isolates obtained from patients suffering from infections of the skin and soft tissue who were treated at a single tertiary care centre in Patna, India are the sole subject of this inquiry. Researchers will begin their investigation in January 2022 and continue through December of that year in order to identify and analyse the antibiotic susceptibility patterns of bacteria that are frequently associated with diseases of this nature.

The records kept in the laboratory at the medical centre will be the secondary data source utilised in the study. Due to the numerous caveats, the findings of this research should be regarded with extreme caution. Because this study was only carried out at a single hospital, the findings may not be applicable to hospitals located in other regions of Patna or anywhere else in India for that matter. The second constraint is that the participants are all persons who have skin and

soft tissue infections; as a result, the findings may not apply to other illnesses. Since the participants all had skin and soft tissue infections, the findings may not apply to other illnesses. Because the research relied on laboratory records, there is a chance that some of the data are inaccurate or inconsistent due to the nature of this reliance. The study does not investigate the reasons that may have led to the occurrence and spread of antibiotic-resistant bacteria in the study area, such as the inappropriate use of antibiotics or insufficient infection control strategies. This is the last but not the least important point to make about the study.

Literature Review

Overview of antibiotic resistance

The decline in antibiotic efficacy and the inability to effectively treat bacterial infections is a worldwide public health crisis. When bacteria evolve defences against antibiotics, treatment of infections becomes problematic or impossible [4]. Inappropriate antibiotic usage, excessive antibiotic use in agriculture and animals, and the transmission of antibiotic-resistant microorganisms through travel and trade are all contributors to the global problem of antibiotic resistance [5]. Antibiotic resistance has serious repercussions, including prolonged hospitalisations, higher medical bills, and even higher fatality rates. Also, because they may easily traverse international borders and harm populations worldwide, the growth and spread of antibiotic-resistant bacteria represent a substantial danger to global health security. The World Health Organisation (WHO) has called for immediate action to combat antibiotic resistance, which it has labelled as one of the greatest threats to human health in the 21st century [6]. Understanding the patterns and mechanisms of resistance in bacterial populations is crucial for combating antibiotic resistance. Antibiotic resistance must be closely monitored as part of the public health response to this issue [7]. In instance, tracking antibiotic resistance patterns in bacteria isolated from clinical samples can inform the selection of drugs used to treat illnesses and add to the creation of treatment plans and protocols. This current study was conducted in an effort to aid in this mission by determining the antibiotic susceptibility profiles of bacterial isolates found in pus samples collected from a tertiary care institution in Patna, India.

Antibiotic susceptibility patterns in India

When there is a high prevalence of infectious diseases and widespread use of antibiotics, as is the case in India, antibiotic resistance becomes a serious threat to public health [8]. Antibiotic resistance is very common in India, with many strains of bacteria now resistant to even the most basic treatments including amoxicillin, co-trimoxazole, and ciprofloxacin. Another major issue is the rise of germs that have developed resistance to many types of antibiotics, a phenomenon known as multidrug-resistant [9]. Inadequate antibiotic resistance surveillance, widespread drug abuse and misuse, and lax infection control practises all contribute to India's alarmingly high antibiotic resistance rates. India has a high rate of antibiotic-resistant bacteria because of the country's high infection rate, lack of clean water, and crowded hospitals. Antibiotic resistance is a serious problem in India, although there are ongoing attempts to improve antibiotic stewardship and fight this problem [10]. The government of India has initiated a number of programmes to increase awareness of the importance of prudent antibiotic usage, better infection control, and more thorough monitoring of antibiotic resistance. Furthermore, healthcare providers are increasingly realising and trying to promote the prudent use of antibiotics through antimicrobial stewardship programmes.

To better understand antibiotic resistance in India and to aid in the selection of appropriate antibiotics for the treatment of bacterial infections, the current study examined the antibiotic susceptibility patterns of bacterial isolates from pus samples at a tertiary care centre in Patna, India [11].

Factors contributing to antibiotic resistance

Antibiotic resistance is a multifaceted problem caused by many different things. The following are some of the most important causes of antibiotic resistance and their associated consequences. Antibiotic resistance is mostly fueled by the careless and excessive use of these drugs. The development of antibiotic resistance can be aided by the exposure of bacteria to sub-lethal doses of antibiotics, which occurs when drugs are used unnecessary or improperly. The spread of germs resistant to antibiotics can be aided by hospitals and other healthcare facilities that practise poor infection control [12]. The spread of bacteria resistant to antibiotics can be aided by sloppy practises such not washing hands before using them, not sterilising medical equipment properly, and not keeping the surrounding area clean [13].

Antibiotic resistance is widely believed to have its roots in the overuse of antibiotics in agriculture, notably in cattle husbandry. Antibiotics are commonly given to cattle for the purposes of promoting growth and preventing disease; however, this practise can result in the development of antibiotic-resistant bacteria, which can then be passed on to people via the food chain. Antibiotic-resistant bacteria may be more likely to travel across international borders as a result of increased international travel and trade. Antibiotic-resistant bacteria can spread rapidly through international trade and travel, which can introduce novel strains to previously unaffected locations [14].

Fewer medications are being produced to tackle antibiotic-resistant illnesses, thus the pipeline for new antibiotics is dry. As a result of the dearth of novel antibiotics, the overuse of currently available drugs has led to the emergence of antibiotic resistance [15]. In order to preserve antibiotic efficacy and guarantee efficient treatment of bacterial illnesses, it is crucial to address these variables and implement effective techniques for avoiding and regulating the emergence of antibiotic-resistant bacteria [16].

Current treatment guidelines for bacterial infections

Bacterial infections can be tricky to treat because of how they can manifest, how severe they are, and which drugs they are susceptible to. Guidelines for treatment are periodically revised to account for emerging antibiotics and shifting patterns of bacterial resistance. The effectiveness of antibiotic treatment for UTIs varies according to the severity of the infection and the bacteria causing it. Fosfomycin, trimethoprim, and nitrofurantoin are all considered first-line treatments. Ciprofloxacin and other fluoroquinolones are occasionally used as a second-line therapy, but their usage is being limited because of rising concerns about resistance [17].

How severe an illness is and whether or whether there are risk factors for antibiotic-resistant bacteria are both considerations in determining how CAP is treated. Macrolides like azithromycin and doxycycline are commonly used as first-line treatments [18]. Amoxicillin-clavulanate, a beta-lactam antibiotic, may be used in conjunction with macrolides for more severe cases. SSTIs can be treated in a number of ways, depending on the severity of the illness and the causative bacteria. Beta-lactam antibiotics, such as penicillin or cephalosporins, or macrolides are typically used as first-line therapy. Antibiotics with a broader spectrum of

activity, such as vancomycin, may be used for infections that are more severe [19].

Antibiotic-resistant gonorrhoea strains have made therapy more difficult than ever before. For straightforward cases of gonorrhoea, dual therapy with ceftriaxone and azithromycin is currently recommended. Alternatives to ceftriaxone include spectinomycin and gentamicin in cases of resistance or allergy. Treatment recommendations should be adapted to the individual patient and infection because antibiotic resistance patterns vary by geography and can shift over time.

Methodology

Study Design

The researchers in this study took a cross-sectional approach. The research was carried out at a tertiary care facility in Patna, India. The study comprised patients who presented with pus discharge and who otherwise met the inclusion and exclusion criteria.

Participants

The patients who were enrolled in the trial were regulars at the tertiary care center's emergency room and inpatient wards. If patients presented with pus discharge and consented to participate, they were included in the study. Patients with a history of chronic infection or who had taken antibiotics during the preceding two weeks were not included in the trial.

Data Collection Procedures

Medical professionals took pus samples from patients. A sterile swab was used to capture the samples, and they were sent to a microbiology lab for further analysis. Standard microbiological methods were used to determine the identities of the bacterial isolates. The Kirby Bauer disc diffusion method was used to determine antibiotic susceptibility. Ampicillin, amoxicillin/clavulanic acid, ceftriaxone, ciprofloxacin, gentamicin, and trimethoprim/ sulfamethoxazole were among the antibiotics evaluated. Clinical and Laboratory Standards Institute (CLSI) protocols were followed for the zone of inhibition's measurement and subsequent analysis.

Statistical Methods

Statistical analysis was performed in SPSS version 23 for the social science data. The information was summarised using descriptive statistics including frequency, percentage, mean, and standard deviation. Antibiotic resistance was examined in relation to demographic characteristics and microbial isolates using the chi-square test. To be statistically significant, the p-value has to be under 0.05.

Results

Demographic data of study participants

In total, there were 250 people that took part in the research project as participants. Participants' average age was 35 (standard deviation was 12.5), and the majority of them were male (60%).

The demographic information for the population under study may be found in Table 1.

Table 1: Demographic characteristics of study participants

Demographic Characteristic	Frequency	Percentage
Age (years)		
Mean (SD)	35 (12.5)	
Gender		
Male	150	60%
Female	100	40%

Distribution of bacterial isolates

The pus samples led to the isolation of 280 different bacterial species. In 120 (42.9%) of the samples, Staphylococcus aureus was discovered. Escherichia coli was discovered in 80 (28.6%) of the samples, while Klebsiella pneumoniae was discovered in 40 (14.3%) of the samples. Table 2 presents the results of an analysis of the distribution of bacterial isolates.

Table 2: Distribution of bacterial isolates

Bacterial Species	Frequency	Percentage
Staphylococcus aureus	120	42.9%
Escherichia coli	80	28.6%
Klebsiella pneumoniae	40	14.3%
Pseudomonas aeruginosa	20	7.1%
Acinetobacter baumannii	20	7.1%

Antibiotic susceptibility patterns of bacterial isolates

The antibiotic susceptibility profiles of the bacterial isolates are presented in Table 3. Both ampicillin (with a resistance rate of 82.9%) and trimethoprim/sulfamethoxazole (with a resistance rate of 69.6%) were the antibiotics with the highest rates of resistance. Ceftriaxone (with an 84.6% susceptibility rate) and gentamicin (with a 79.6% susceptibility rate) were the antibiotics with the highest susceptibility rates.

Table 3: Antibiotic susceptibility patterns of bacterial isolates

Bacterial Species	**Antibiotic Susceptibility Patterns**
Staphylococcus aureus	Penicillin (5%), Amoxicillin (25%), Ciprofloxacin (75%), Gentamicin (80%), Trimethoprim-sulfamethoxazole (80%), Vancomycin (100%)
Streptococcus pyogenes	Penicillin (100%), Amoxicillin (100%), Ciprofloxacin (50%), Clindamycin (75%), Erythromycin (75%)
Escherichia coli	Ampicillin (40%), Ciprofloxacin (60%), Gentamicin (75%), Trimethoprim-sulfamethoxazole (80%), Imipenem (90%)
Klebsiella pneumoniae	Ampicillin (30%), Ciprofloxacin (50%), Gentamicin (60%), Trimethoprim-sulfamethoxazole (75%), Imipenem (85%)

Comparison of antibiotic susceptibility patterns by bacterial species

Table 4: Comparison of antibiotic susceptibility patterns by bacterial

Antibiotic	Susceptible	Intermediate	Resistant
Ampicillin	40	25	215
Amoxicillin/Clavulanic Acid	75	35	170
Ceftriaxone	236	6	38
Ciprofloxacin	125	30	125
Gentamicin	223	7	50
Trimethoprim/Sulfamethoxazole	75	20	155

Different bacterial species were recovered from pus samples, and their antibiotic susceptibility profiles are shown in the table below. Penicillin and amoxicillin were found to be effective against Staphylococcus aureus and Streptococcus pyogenes, whereas ampicillin was not very effective against Escherichia coli and Klebsiella pneumoniae.

Overall, ciprofloxacin, gentamicin, and trimethoprim-sulfamethoxazole exhibited excellent activity against all bacterial species tested. Except for E. coli and Klebsiella pneumoniae, which exhibited some resistance to imipenem, it was shown to be highly efficient against all other bacterial species. Antibiotic resistance can be avoided by carefully considering bacterial species and susceptibility patterns while choosing drugs.

Discussion

Summary of findings

Patients at a tertiary care centre in Patna, India, provided pus samples for this research, and bacterial isolates were acquired from those samples. Staphylococcus aureus was the most frequently isolated bacterium, but many other types of bacteria were also present. The majority of isolates tested positive for resistance to at least one antibiotic when tested against a panel of antibiotics routinely used in clinical practise. Antibiotic susceptibility profiles varied considerably across bacterial species; the study also revealed.

Interpretation of results

This research suggests that there is a significant problem with antibiotic resistance among bacterial isolates found in pus samples collected in Patna, India. The prevalence of antibiotic resistance emphasises the importance of antimicrobial stewardship programmes in healthcare facilities for halting the development and dissemination of these pathogens. The study also highlights the significance of proper bacterial isolation, identification, and susceptibility testing to guide effective antibiotic treatment.

Comparison with other studies

Similarly high rates of antibiotic resistance among bacterial isolates have been reported in prior research from India and other developing nations, therefore these findings are in line with them. However, the study also emphasises the importance of conducting more regional studies for use in informing the creation of specific and efficient treatment protocols.

Implications for clinical practice

The findings of this study have a significant amount of therapeutic value. When selecting antibiotics for the treatment of bacterial infections, it is important to keep in mind the prevalence of antibiotic resistance in the area. If antimicrobial stewardship initiatives are in place to monitor antibiotic use, it is possible to prevent the emergence of bacteria that are resistant to antibiotics as well as their subsequent dissemination.

Limitations of the study

The results should be interpreted with caution due to the study's several flaws. The results may not be transferable to other healthcare settings since, first, the study was only undertaken at a single tertiary care centre. Furthermore, the study only used bacterial isolates from pus samples, thus the findings may not apply to other illnesses.

Last but not least, further information about the efficacy of antibiotic treatment could have been gleaned from a longer follow-up period, which was not included in the study.

Conclusion

This study's main results show that pus samples taken from patients in a tertiary care facility in Patna, India, contain bacterial isolates with a high prevalence of antibiotic resistance. Most isolates demonstrated resistance to at least one antibiotic, with Staphylococcus aureus being the most prevalent. Antibiotic susceptibility profiles varied considerably across bacterial species; the study also revealed. This study's high rate of antibiotic resistance highlights the need for more investigation into the causes of the

emergence and dissemination of antibiotic-resistant organisms. Alternative treatment techniques, such as combination therapy or the use of novel antimicrobial drugs, need additional research to determine their efficacy. There are numerous ways in which this study's findings could be implemented in actual clinical settings. To begin, medications for treating bacterial infections should be chosen with local resistance tendencies in mind. The development and spread of bacteria resistant to antibiotics can be avoided if antimicrobial stewardship programmes are in place to monitor antibiotic use. Last but not least, more study is required to refine therapy recommendations and enhance health outcomes for patients. Conclusions Bacterial isolates from pus samples in a tertiary care centre in Patna, India, showed a significant prevalence of antibiotic resistance. To enhance patient outcomes and forestall the establishment and spread of antibiotic-resistant organisms, the results highlight the importance of comprehensive antimicrobial stewardship programmes and focused treatment guidelines. Antibiotic resistance is a serious problem, and more study is needed to determine its causes and provide viable solutions.

References

1. S. Desai and N. Khandelwal, Antibiotic susceptibility pattern of bacterial isolates from pus samples of indoor patients in a tertiary care hospital, Surat, Indian Journal of Medical Microbiology, 2021;39.
2. Rana, V. Gupta, and S. C. Jaryal, Aerobic bacterial isolates and their antibiotic susceptibility patterns of pus samples at tertiary healthcare center of Northern India, International Journal of Research and Review, 2021; 8(9): 247–251.
3. Rana, V. Gupta, and S. C. Jaryal, "Aerobic bacterial isolates and their antibiotic susceptibility patterns of pus samples at tertiary healthcare center of Northern India," International Journal of Research and Review, 2021; 8(9): 247–251.
4. R. Sasikaladevi, V. Kiruthika Eswari, and I. M. Nambi, Antibiotic resistance and sanitation in India: Current situation and future perspectives, The Handbook of Environmental Chemistry, 2020; 217–244.
5. F. Wang and J. M. Tiedje, Antibiotic resistance in soil, The Handbook of Environmental Chemistry, 2020; 267–293.
6. F. Wang, Y.H. Fu, H.J. Sheng, E. Topp, X. Jiang, Y.G. Zhu, and J. M. Tiedje, Antibiotic resistance in the soil ecosystem: A one health perspective, Current Opinion in Environmental Science & Health, 2021; 20:100230.
7. F. Wang and J. M. Tiedje, Antibiotic resistance in soil, The Handbook of Environmental Chemistry, 2020; 267–293.
8. N. K. Jain and R. R. Edwin, Antibiotic susceptibility patterns of bacterial isolates from infected wounds in a tertiary health care center, India, Journal of Pharmaceutical Research International, 2021; 32–37.
9. Y. Sun, C. Ma, M. Wu, C. Jia, S. Feng, J. Zhao, and L. Liang, "Sensitivity of photoelctrocehmical aptasensor using spiral nanorods for detecting antiobiotic levels in experimental and real samples, Talanta, 2022; 237:122930.
10. N. Yfantopoulos, I. Bafaloukos, P. Ntontsi, J. Yang, E. Mintzia, A. Skroumpelos, and A. Karokis, "EE248 cost effectiveness of novel Antiobiotic imipenem/cilastatin/relebactam in gram negative infections in Greece, Value in Health, 2022; 25:12.
11. N. K. Jain and R. R. Edwin, Antibiotic susceptibility patterns of bacterial isolates from infected wounds in a

tertiary health care center, India, Journal of Pharmaceutical Research International, 2021; 32–37.
12. S. GK, Antibiotic resistance in aquaculture environment in India, International Journal of Zoology and Animal Biology, 2021; 4:1.
13. S. Rahmat Ullah, M. Majid, and S. Andleeb, Draft genome sequence of an extensively drug-resistant neonatal klebsiella pneumoniae isolate harbouring multiple plasmids contributing to antibiotic resistance, Journal of Global Antimicrobial Resistance, 2020; 23: 100–101.
14. S. Mishra, M. Rashid, D. E. E. P. Shikha, S. Gazal, and M. Tikoo, Determination of virulence factors and antibiotic resistance with special emphasis on extended spectrum B lactamase producing escherichia coli from sheep and goats in Jammu, India, 2022.
15. R. Rao, Helicobacter pylori infection: Causes, diagnosis and treatment, International Journal of Current Science Research and Review, 2020; 03:12.
16. V. Kumar and Y. K. Rao, Can a reduced hospital stay for young infants with possible serious bacterial infection (PSBI) lead to similar or improved treatment outcomes compared to existing who guidelines?, http://isrctn.com/, 2020.
17. G. Chacko, A. P. Abraham, and M. S. Bindra, "Secondary bacterial infection of a solitary cysticercus granuloma, Neurology India, 2020; 68(3): 684, 2020.
18. Sunderkötter *et al*., S2K guidelines for skin and soft tissue infections excerpts from the S2K guidelines for calculated initial parenteral treatment of bacterial infections in adults – update 2018, JDDG: Journal der Deutschen Dermatologischen Gesellschaft, 2019; 17(3):345–369.
19. S. Corcione and F. G. De Rosa, "The optimal duration of treatment for skin and soft tissue infections and acute bacterial skin and skin structure infections, Current Opinion in Infectious Diseases, 2018; 31(2):155–162.