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Patient Profile and Antimicrobial Susceptibility Testing of Clinically Isolates in *E. coli*

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Abstract

Escherichia coli, commonly known as E. coli, is a prevalent bacterium capable of causing infections in humans. The development of antimicrobial resistance in E. coli poses a significant public health issue. This study aimed to determine the patient profile and antimicrobial susceptibility patterns of clinically isolated E. coli. A retrospective study was carried out on E. coli samples collected from clinical specimens within a hospital environment. Patient profiles, including age, gender, and underlying medical conditions, were recorded. Standard methods were employed to conduct antimicrobial susceptibility testing on the E. coli isolates, with interpretation of the results based on clinical breakpoints advised by the Clinical and Laboratory Standards Institute. The patient profile and antimicrobial susceptibility patterns of E. coli isolates were analyzed and presented. Descriptive statistics showed that the majority of patients were female and had urinary tract infections. Antimicrobial susceptibility testing revealed that E. coli isolates were highly resistant to ampicillin and sulfamethoxazole/trimethoprim, but susceptible to carbapenems and amino glycosides. Correlations of notable significance were identified between age and antimicrobial resistance. These findings can inform the development of effective treatment strategies and antimicrobial stewardship programs to combat the spread of antimicrobial resistance in E. coli. The result of antibiotic susceptibility testing revealed varying patterns of resistance among the Escherichia coli isolates. Some strains exhibited a high degree of susceptibility to multiple antibiotics, while others demonstrated resistance, particularly to certain classes of antibiotics. Data analysis highlighted notable trends and correlations between specific antibiotics and resistance patterns. These findings hold crucial implications for informing suitable treatment approaches for Escherichia coli infections. Understanding the antibiotic susceptibility pattern of clinically isolated strains can aid healthcare providers in selecting effective antimicrobial therapies and minimizing the spread of resistant strains.

Keywords: *Escherichia coli*, antibiotics, antimicrobial susceptibility test, model organism, culture media

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INTRODUCTION

Escherichia coli (*E. coli*) is a gram-negative bacterium typically present in the gastrointestinal tract of both humans and animals. While most *E. coli* strains are benign, certain variants have the potential to provoke severe infections, including urinary tract infections, bloodstream infections, and meningitis. Antimicrobial resistance in *E. coli* has become a major global health concern because it can limit the effectiveness of treatment options and increase the risk of complications and mortality. Microscopic view of the gram stain showing rod-shaped *E. coli* (Figure 1).

Morphology

- It is a gram-negative, straight rod measuring 1.0 to 2.0 micrometers long with a radius of about 0.5 micrometers, arranged singly or in pairs.
- It exhibits motility through peristriate flagella, although certain strains may lack this capability.
- Certain virulent strains possess capsules and fimbriae.

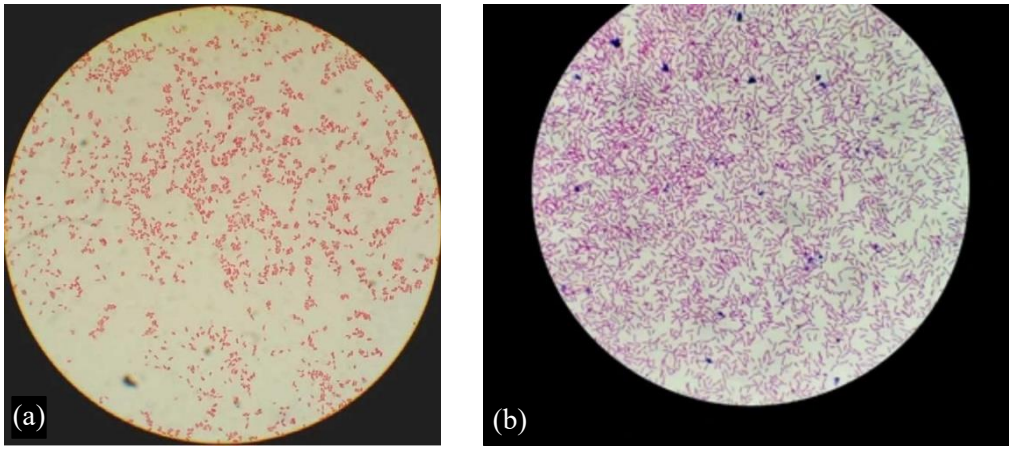

Figure 1. (a) and (b) Microscopic view of gram stain showing rod-shaped *E. coli*.

Antimicrobial susceptibility testing is an essential tool for guiding the selection of appropriate antimicrobial therapies for bacterial infections [1]. The Clinical and Laboratory Standards Institute (CLSI) provides clinical breakpoints for interpreting the results of antimicrobial susceptibility testing and determining the most effective treatment options. However, the prevalence of antimicrobial resistance in *E. coli* is constantly evolving, and understanding the patterns of resistance is essential for effective treatment and antimicrobial stewardship [2].

In addition to the antimicrobial susceptibility patterns of *E. coli*, the patient profiles of those infected with this bacterium can also provide valuable insights. Understanding the patient profile, including age, sex, and underlying medical conditions, can help identify the risk factors for *E. coli* infections and inform treatment strategies.

Therefore, this study aimed to determine the patient profile and antimicrobial susceptibility patterns of clinically isolated *E. coli* strains in a hospital setting. The findings of this study will inform the development of effective treatment strategies and antimicrobial stewardship programs to combat the spread of antimicrobial resistance in *E. coli*.

To this end, clinically relevant strains of Escherichia coli were isolated from various clinical specimens, including urine, blood, and stool samples. These isolates were then subjected to antibiotic susceptibility testing using established methods such as the disk diffusion method or broth dilution method. Multiple antibiotics, commonly used in clinical practice, were selected for testing, representing different classes and mechanisms of action.

The findings of this project will provide valuable information on the susceptibility profiles of clinically isolated Escherichia coli strains, helping to identify patterns of resistance and assess the efficacy of commonly used antibiotics. This knowledge can aid healthcare professionals in making informed decisions when prescribing antibiotics, optimizing patient outcomes, and minimizing the spread of resistant strains within healthcare settings [3].

Understanding the antibiotic susceptibility patterns of Escherichia coli is essential for implementing effective infection control measures and antibiotic stewardship programs. By identifying emerging

trends in antibiotic resistance, healthcare facilities can tailor their strategies to prevent the dissemination of antibiotic-resistant strains, preserve the effectiveness of available antibiotics, and contribute to the overall effort to combat antibiotic resistance. Most *E. coli* strains are innocuous or even advantageous, whereas certain varieties have the potential to induce illnesses ranging from minor gastrointestinal discomfort to serious infections. Pathogenic strains of *E. coli* are categorized into different serotypes based on their surface antigens, with the most common serotype being *E. coli* O157:H7.

E. coli infections commonly spread through ingestion of contaminated food or water or contact with fecal matter from infected humans or animals. Poor food handling practices, insufficient sanitation measures, and contaminated water supplies can facilitate bacterial transmission [4].

Infections caused by pathogenic *E. coli* can lead to a variety of symptoms including diarrhea (which can be bloody), abdominal cramps, nausea, vomiting, and fever. Although most cases resolve without issues, severe infections may lead to hemolytic uremic syndrome (HUS), which involves the breakdown of red blood cells and kidney failure. This complication is particularly prevalent in young children and older individuals.

Prevention of *E. coli* infection entails maintaining good hygiene practices, including thorough handwashing, safe handling and preparation of food, and adequate sanitation measures. Additionally, it is crucial to consume properly cooked food and ensure access to safe drinking water.

In scientific research, *E. coli* has been widely used as a model organism owing to its ease of cultivation and manipulation in the laboratory. Its genetic simplicity and well-characterized genome have made it a valuable tool for studying fundamental biological processes and producing various proteins and enzymes through genetic engineering techniques [5–6].

1. *E. coli strains*: *E. coli* comprises a wide spectrum of strains that exhibit diverse characteristics. Although certain strains are benign and contribute to the natural gut microbiota, others have the potential to trigger infections. Pathogenic variants of *E. coli* are commonly categorized into distinct groups, including enterotoxigenic *E. coli* (ETEC), enterohemorrhagic *E. coli* (EHEC), enteropathogenic *E. coli* (EPEC), enteroinvasive *E. coli* (EIEC), and enteroaggregative *E. coli* (EAEC). Each strain has specific virulence factors and modes of infection.
2. *E. coli and foodborne illness:* Contaminated food, especially undercooked ground.
3. Beef, raw fruits and vegetables, unpasteurized dairy products, and contaminated water can be sources of *E. coli* infections. Improper food handling, inadequate hygiene practices, and cross-contamination during food processing can contribute to the spread of bacteria [7].
4. *E. coli outbreaks: E. coli outbreaks have occurred in various parts of the world often:* associated with contaminated food or water. These outbreaks can affect individuals in localized communities or have a broader impact on a larger population. Public health authorities closely monitor and investigate outbreaks to prevent further infections and ensure public safety.
5. *Antibiotic resistance:* Over the years, certain strains of *E. coli* have evolved resistance to commonly used antibiotics, presenting obstacles in effectively treating infections. This underscores the significance of prudent antibiotic administration and the necessity for continuous research aimed at devising novel antimicrobial approaches.
6. *E. coli in biotechnology*: *E. coli* has been extensively used in biotechnology and recombinant DNA technology. Its genetic engineering capabilities make it a popular host for producing various proteins, enzymes, and pharmaceuticals. *E. coli*'s well-characterized genome and rapid growth rate of *E. coli* enable scientists to modify their genetic material and study the function of specific genes.
7. *E. coli in water quality monitoring: E. coli* is used as an indicator organism to assess water quality and detect fecal contamination in environmental samples. The presence of *E. coli* in water indicates potential contamination by other harmful pathogens, emphasizing the need for water treatment and sanitation measures [8].

8. *Research and scientific significance: E. coli* has played a pivotal role in scientific discoveries, such as understanding DNA replication, transcription, and translation. The use of *E. coli* in research has contributed to advancements in fields, such as molecular biology, genetics, and biotechnology.
9. *E. coli in the environment:* Apart from its presence in the intestines of humans and animals, *E. coli* can be found in the environment, such as soil, water, and vegetation. Although some environmental strains are harmless, certain pathogenic strains can survive outside the host and pose a risk if they come into contact with humans through contaminated recreational waters or agricultural products.
10. *Shiga toxin-producing E. coli (STEC):* One of the most well-known pathogenic strains of *E. coli* is *E. coli* O157:H7, which is classified as a Shiga toxin-producing *E. coli* (STEC). These strains generate powerful toxins known as Shiga toxins, which are capable of inducing severe illnesses in humans. STEC infections are often associated with the consumption of undercooked ground beef, unpasteurized milk, contaminated vegetables, and other food products.
11. *Traveler's diarrhea: E. coli* is a common cause of traveler's diarrhea, which is an intestinal infection often experienced by individuals traveling to regions with inadequate sanitation and hygiene practices. Traveler's diarrhea is usually a temporary condition that resolves spontaneously within a short span; however, it can result in notable discomfort and interfere with travel arrangements.
12. *E. coli and biofilms: E. coli* can form biofilms, which are communities of bacteria encased in a protective matrix. Biofilms enable *E. coli* to adhere to surfaces and increase their resistance to antimicrobial agents and the host immune system. Biofilms have the potential to be developed on medical instruments such as catheters, resulting in enduring infections and associated complications.
13. *E. coli as a research tool: E. coli* has been extensively used in molecular biology research and as a host for recombinant DNA technology. Its well-characterized genetics and ease of manipulation have allowed scientists to study gene expression, protein production, and various cellular processes. *E. coli*'s use as a research tool has contributed to advancements in fields like genetic engineering, synthetic biology, and biopharmaceutical production [9].
14. *E. coli vaccines:* Researchers have developed vaccines to prevent certain strains of pathogenic *E. coli*. For example, vaccines targeting specific serotypes of *E. coli* O157:H7 have been developed and tested for efficacy in reducing the risk of infection. Effective vaccination strategies are crucial for managing and preventing illnesses associated with *E. coli* infection.
15. *E. coli and water treatment:* The identification of *E. coli* in water samples serves as a marker of fecal contamination. Water treatment facilities monitor and test *E. coli* to ensure drinking water safety. The presence of *E. coli* in water sources indicates the presence of other pathogenic bacteria and viruses, highlighting the importance of effective water treatment processes.
16. *E. coli and antibiotic-resistant infections:* In recent times, increasing apprehension has arisen regarding the emergence of *E. coli* strains. Some *E. coli* strains acquire genes that confer resistance to multiple antibiotics, making them challenging to treat. Resistance can arise either from genetic mutations within the bacterium or from the acquisition of resistance genes from other bacterial sources. Antibiotic stewardship and the development of new treatment strategies are crucial for combating these resistant strains.
17. *E. coli as a model organism: E. coli* has been used as a model organism for studying fundamental biological processes and molecular genetics because of its straightforward cellular organization, rapid proliferation, and comprehensive study of genetic makeup. Escherichia coli is considered an excellent candidate for scientific investigation. *E. coli* has contributed to significant breakthroughs in the understanding of DNA replication, gene regulation, protein synthesis, and other fundamental biological mechanisms.
18. *E. coli and recombinant DNA technology:* The versatility and ease of genetic manipulation of *E. coli* have made it a workhorse in recombinant DNA technology. Scientists can introduce foreign DNA into *E. coli* cells and use these bacteria as "factories" to produce proteins of interest on a

large scale. It has applications in medicine, industry, and biotechnology, enabling the production of therapeutic proteins, enzymes, and biofuels.

19. *E. coli and food safety regulations:* Due to the potential health risks associated with certain strains of *E. coli*, food safety regulations have been implemented to minimize the occurrence of foodborne illnesses. These regulations include stringent standards for food processing, handling, and sanitation to prevent contamination and ensure the safety of food products. Regular testing and monitoring of *E. coli* in food production facilities are essential for maintaining food safety.
20. *E. coli in veterinary medicine: E. coli* infections can affect animals, including livestock and pets. In veterinary medicine, *E. coli* is a major cause of enteric diseases in animals, leading to diarrhea, dehydration, and sometimes death. Appropriate animal husbandry practices, hygiene, and vaccination programs are important for preventing and managing *E. coli* infections in veterinary settings.
21. *E. coli and genomic studies:* The sequencing and analysis of *E. coli* genomes have provided valuable insights into the genetic diversity and evolution of the species. Comparative genomics studies have revealed genetic differences between pathogenic and non-pathogenic strains, helping to identify virulence factors and understand the mechanisms of pathogenesis [10].
22. *E. coli and environmental applications:* Escherichia coli extends its utility beyond laboratory settings. Certain strains have been genetically modified for environmental functions such as bioremediation. These strains can be used to break down pollutants and contaminants in soil, water, and industrial waste, contributing to environmental cleanup.
23. *E. coli and the gut microbiome:* Escherichia coli is a notable constituent of the gut microbiota, which encompasses various microorganisms inhabiting the human gastrointestinal system. It plays a crucial role in maintaining gut health by competing with harmful bacteria, producing essential vitamins, and contributing to digestion and absorption of nutrients.
24. *E. coli as a bioreactor: E. coli* has been engineered to act as a bioreactor for the production of a wide range of compounds including biofuels, pharmaceuticals, and industrial chemicals. By introducing specific genetic modifications, scientists can optimize *E. coli* metabolic pathways to efficiently produce desired products [11–12].
25. *E. coli and gene expression regulation: E. coli* has been extensively studied for its mechanisms of gene expression regulation. Researchers have identified various regulatory elements, such as transcription factors and small RNA molecules, that control gene activity in response to environmental cues. Understanding these regulatory mechanisms in *E. coli* has broad implications for deciphering gene regulation in other organisms.

Cultural Characteristics

- It grows aerobically and is a facultative anaerobic. The temperature ranged from 10°C to 40°C, with an optimal temperature of 37°C.
- It grows well in ordinary medium. The colonies are large, grayish, moist, smooth, opaque, or partially translucent and discoid.
- On blood agar, many strains, especially those associated with infection, are hemolytic.
- On MacConkey agar, colonies exhibited a vibrant pink coloration as a result of lactose fermentation [Figure 2 (a) and (b)].
- On selective media, growth is largely inhibited, such as DCA or SS agar, which is used for the isolation of Salmonella and Shigella.
- In Broth, growth occurs with uniform turbidity and heavy deposits, which disperse completely on shaking.

Aim & Objective

Aim

This dissertation aimed to assess the antibiotic susceptibility patterns of clinically isolated Escherichia coli strains, focusing on understanding the prevalence of resistance to commonly used antibiotics. By conducting comprehensive antibiotic susceptibility testing, we aimed to identify the most

effective treatment options for *E. coli* infections and provide valuable insights into the emergence and spread of antibiotic resistance. This study seeks to contribute to the optimization of patient management strategies, implementation of effective infection control measures, and preservation of antibiotics.

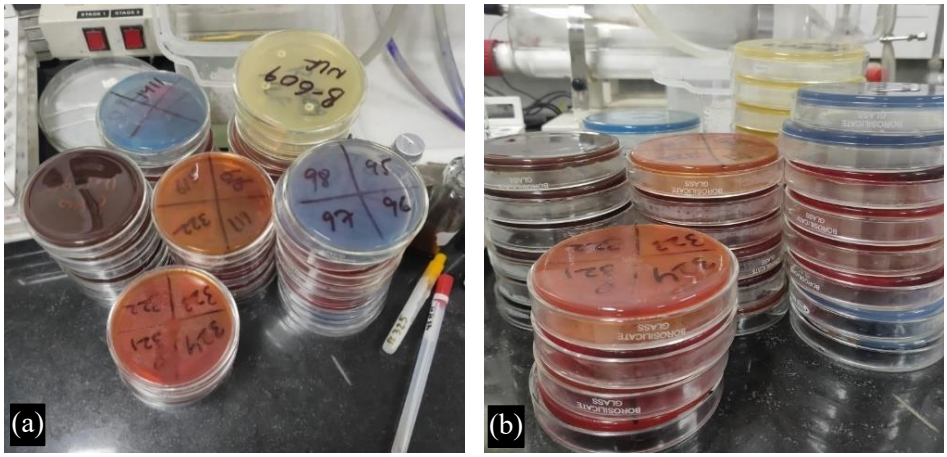

Figure 2. (a) and (b) Different types of culture media.

Objective

1. To determine the patient profile of clinically isolated *E. coli*, including age, sex, and underlying medical condition.
2. antimicrobial susceptibility testing was conducted on *E. coli* isolates, and outcomes were interpreted based on the clinical breakpoints recommended by the Clinical and Laboratory Standards Institute.
3. To analyze the antimicrobial susceptibility patterns of *E. coli* isolates and to identify any trends or associations with patient characteristics.
4. To evaluate the frequency of antimicrobial resistance among *E. coli* isolates, the prevailing resistance patterns were determined.
5. This study contributes to the understanding of emerging resistance trends in Escherichia coli by analyzing recent data.
6. The objective of this study was to explore the presence of known resistance genes, such as ESBLs or plasmid-mediated resistance genes, as well as mutations in target genes associated with resistance.
7. Investigate the correlation between specific genetic markers, such as resistance genes or genetic mutations, and the observed resistance patterns.
8. The objective is to provide data that can be integrated into larger databases or surveillance networks to facilitate the identification of global resistance patterns and inform public health interventions on a border scale.
9. Additionally, the project aimed to investigate the underlying mechanisms of resistance, including the presence of resistance genes, efflux pumps, or alterations in drug targets. Understanding these mechanisms will offer insights into the genetic foundations of antibiotic resistance and aid in devising tailored treatment approaches.
10. Moreover, the project seeks to evaluate the clinical outcomes associated with antibiotic-resistant Escherichia coli infections, including the length of hospital stay, treatment failure rates, and mortality rates. By examining these outcomes, this study aimed to highlight the effect of antibiotic resistance on patient morbidity and mortality.

REVIEW OF LITERATURE

Over the past decade, numerous studies have contributed to our understanding of antibiotic resistance in clinically isolated Escherichia coli strains, shedding light on the prevalence, mechanisms, and implications of resistance. These studies have employed various methodologies to assess antibiotic

susceptibility patterns and have provided valuable insights into the evolving landscape of resistance. Studies have shown that the prevalence of antimicrobial resistance in *E. coli* is increasing worldwide. A study conducted in India found that over 80% of *E. coli* isolates were resistant to ampicillin, whereas over 60% were resistant to cotrimoxazole.

1. A study conducted in China found that *E. coli* isolates were highly resistant to cephalosporins, fluoroquinolones, and sulfonamides. The high prevalence of antimicrobial resistance in *E. coli* can be attributed to various factors, including the overuse and misuse of antibiotics, poor infection control practices, and the transmission of resistant strains between humans and animals. Antimicrobial susceptibility testing is crucial to determine the optimal antimicrobial treatment for bacterial infections. The CLSI provides clinical breakpoints for interpreting the results of antimicrobial susceptibility testing and determining the most effective treatment options. However, the prevalence of antimicrobial resistance in *E. coli* is constantly evolving, and understanding its patterns of resistance is essential for effective treatment and antimicrobial stewardship. Studies have shown that patient profiles of those infected with *E. coli* can provide valuable insights. A study conducted in Iran found that female sex, older age, and a history of hospitalization were significant risk factors for tract infections caused by *E. coli*.
2. Another study conducted in Canada found that patients with underlying medical conditions such as diabetes and chronic kidney disease were at a higher risk of bloodstream infections caused by *E. coli*.

   Therefore, this study aimed to determine the patient profile and antimicrobial susceptibility patterns of clinically isolated *E. coli* strains in a hospital setting. The findings of this study will inform the development of effective treatment strategies and antimicrobial stewardship programs to combat the spread of antimicrobial resistance in *E. coli*.
3. In a study by some scientists, a thorough examination of antibiotic resistance in Escherichia coli isolates obtained from clinical samples was undertaken. The authors used both phenotypic and genotypic methods to evaluate the susceptibility profiles and resistance mechanisms of the isolates. This study revealed an increase in resistance to broad-spectrum antibiotics, including fluoroquinolones and extended-spectrum beta-lactams. The emergence of resistant strains, particularly those harboring ESBL genes, highlights the need for vigilant monitoring and infection control practices.
4. Another notable study focused on the molecular mechanisms of antibiotic resistance in Escherichia coli. Through whole-genome sequencing and comparative genomic analysis, the authors identified novel resistance determinants and their associations with specific antibiotic classes. The study emphasized the complex interplay between horizontal gene transfer, mutations, and selective pressure in driving the evolution and dissemination of antibiotic resistance in Escherichia coli.
5. Furthermore, scientists have explored the clinical impact of antibiotic resistance in Escherichia coli bloodstream infections. We conducted a retrospective analysis of patient data to examine the association between resistance profiles and treatment outcomes. This study demonstrated a significant increase in mortality rates and prolonged hospital stays among patients infected with multidrug-resistant strains. These findings highlight the urgent need for effective antibiotic stewardship programs and infection control measures to mitigate the adverse effects of antibiotic resistance.
6. In addition to these individual studies, systematic reviews and meta-analyses have provided comprehensive assessments of antibiotic susceptibility trends in Escherichia coli over the past decade. These analyses synthesized data from multiple studies to identify the most prevalent resistance patterns and assess regional variations. They highlighted the global rise in resistance to critical antibiotics, such as carbapenems, and underscored the urgent need for coordinated efforts to combat the spread of multidrug-resistant strains [13].
7. Collectively, literature from the last ten years has demonstrated the growing threat of antibiotic resistance in clinically isolated Escherichia coli strains. These studies have contributed to our understanding of resistance mechanisms, highlighted the clinical implications of resistance, and

emphasized the importance of surveillance, infection control, and judicious antibiotic use. Building upon this body of knowledge, this project aims to further explore the antibiotic susceptibility patterns of clinically isolated Escherichia coli strains, providing valuable insights for informed decision-making in patient management and public health interventions [14].

MATERIAL AND METHOD

Material

Sample Collection

1. Urine and pus samples (Figure 3) were collected following standard aseptic techniques.
2. The samples were transported to the microbiology laboratory and processed within 2 hours of collection.
3. The samples were inoculated onto appropriate culture media, such as MAC Conkey agar (Figure 4), blood agar, and CLED (cystine-lactose-electrolyte-deficient) agar (Figure 5), using the calibrated loop technique.
4. Inoculation was performed under the biosafety cabinet.
5. The inoculated plates were incubated aerobically at 37°C for 18 to 24 hrs.

Bacterial Identification

1. After incubation, bacterial colonies with characteristic colonies were selected for further identification.
2. Gram staining was performed to determine the gram reaction and cellular morphology of isolates.
3. Biochemical tests, such as catalase, oxidase, and various sugar fermentation tests, were performed to identify the isolates at the species level.

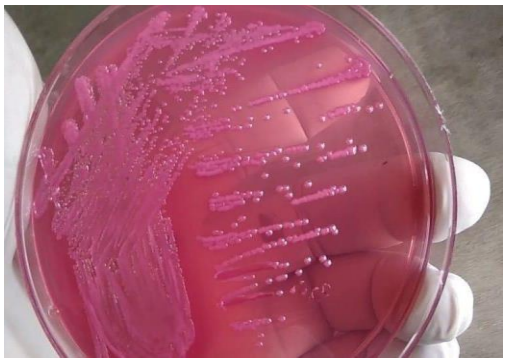

Figure 3. PUS culture of *E. coli*.

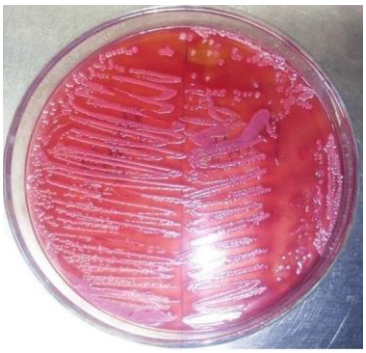

Figure 4. *E. coli* colonies on MacConkey agar.

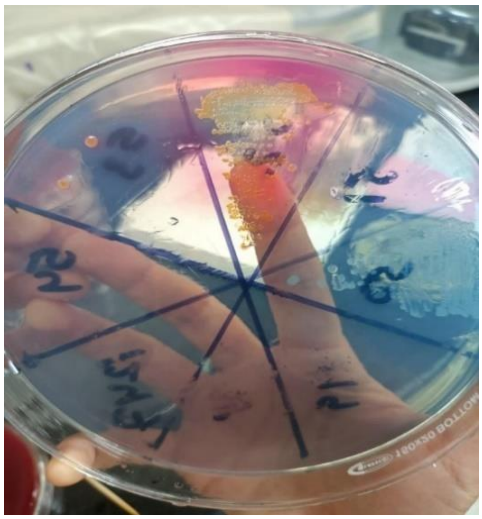

Figure 5. *E. coli* on CLED agar.

Antibiotics and Reagents

A panel of antibiotics, representing different classes and mechanisms of action, was selected for susceptibility testing. This includes [list of antibiotics and their concentrations]. All antibiotics and reagents were obtained from [name and of the supplier or manufacturer].

Antibiotic susceptibility testing:

1. Antibiotic susceptibility testing was performed using the Kirby–Bauer disk diffusion method or automated systems (e.g., Vitek, MicroScan).
2. A panel of antibiotics representing different classes was selected, including beta-lactams, fluoroquinolones, aminoglycosides, and sulfonamides.
3. Mueller-Hinton agar plates were inoculated with standardized bacterial suspensions and antibiotic disks or cartridges were placed on the agar surface.
4. The plates were incubated at the appropriate temperature (usually 35–37°C) for a defined period (e.g., 16–18 hours).
5. The diameter of the zone of inhibition around each antibiotic disk was measured and interpreted based on established interpretive criteria provided by the CLSI guidelines or other recognized standards. Antibiotic Susceptibility Testing (Figure 6(a) and (b)).

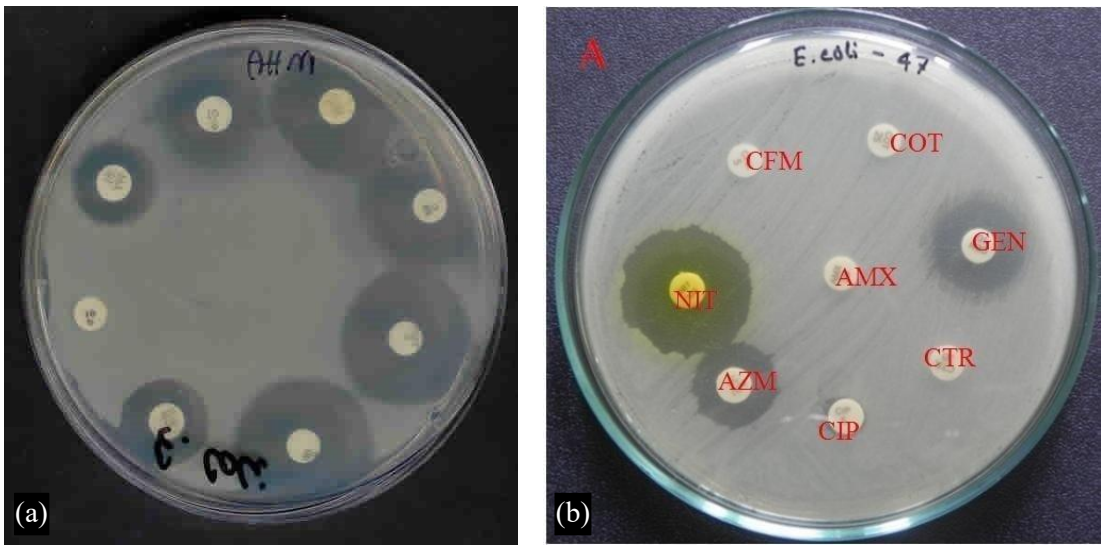

Figure 6. (a) and (b) antimicrobial susceptibility test (AST) of *E. coli*.

Data Analysis

The collected data, including antibiotic susceptibility profiles and genetic analysis results, were compiled and analyzed using appropriate statistical methods.

The clinical outcomes associated with antibiotic-resistant Escherichia coli infections were evaluated, and the effects of resistance on treatment failure rates, length of hospital stay, and mortality rates were assessed.

The Materials and Methods section provides a comprehensive overview of the procedures and techniques employed in the project. It ensures the proper collection and identification of Escherichia coli isolates, accurate antibiotic susceptibility testing, and reliable genetic analysis to explore resistance mechanisms. The data obtained from these methods can be analyzed to draw meaningful conclusions regarding the prevalence, patterns, and clinical implications of antibiotic resistance in clinically isolated Escherichia coli strains. This study provides valuable insights into the patient profile and antimicrobial susceptibility patterns of *E. coli* in hospital settings. Nevertheless, additional investigations are warranted to build upon the results of this study and to pinpoint potential approaches for addressing antimicrobial resistance.

Demographic Profile

The demographic representation of the patients with *E. coli* is depicted in Table 1.

Table 1. This table shows a demographic representation of patients with *E. coli* in their specter based on age sex ward, and types of specimens.

S.N.	Name	Age/sex	Ward	Specimen	Diagnosis	Microscopy
01	Charanjeet	43/M	Medicine ward	Urine	Fever	*E. coli* (cc 10^4 cfu/ml)
02	Radha	22/F	IPD	Urine	Pain in abdomen	*E. coli*
03	Meena	45/F	Gynae ward	Urine	UTI	*E. coli*
04	Bhuri	60/M	OPD	Urine	UTI	*E. coli* (cc > 10^7 cfu/ml
05	Ramandeep	25/F	Emergency ward	Urine	Pain in the lower abdomen	*E. coli* (cc 10^7 cfu/ml)
06	Kusuma	20/F	OPD	Urine	UTI	*E. coli*
07	Rina	24/F	Emergency ward	Urine	Excess white discharge	*E. coli* (cc 10^3 cfu/ml)
08	Malkeet	45/ F	Gynecology OPD	Urine	UTI	*E. coli*
09	Harleen	10/F	OPD	Urine	Fever cough	*E. coli*
10	Raj Kaur	54/F	Medicine OPD	Urine	Fever	*E. coli*
11	Jaspreet	21/F	Gynecology OPD	Urine	UTI	*E. coli* (cc 10^4cfu/ml)
12	Shviam	4/M	Emergency ward	Urine	Fever, stomachache, vomiting	*E. coli* (cc 10^3 cfu/ml)
13	Arshdeep	4/M	Pediatric ward	Urine	Pyrexia of unknown origin	*E. coli* (cc 10^5 cfu/ml)
14	Muskan	22/F	Gynecology ward	Urine	UTI	*E. coli*
15	Pritam	50/M	Medicine ward	Urine	Renal calculi, fever 7 days	*E. coli* (cc 10^4 cfu/ml)
16	Baljeet Kaur	52/F	Emergency ward	Urine	Pain in abdomen	*E. coli*
17	Anchal	19/F	Emergency ward	Urine	Pain in the lower abdomen	*E. coli* (cc 10^4 cfu/ml)
18	Sandeep	9/M	Pediatric OPD	Urine	Fever 14–15 days	*E. coli* (cc 10^3 cfu/ml)
19	Ekampreet	72/F	Medicine OPD	Urine	Pain in abdomen	*E. coli*
20	Robin	9/M	OPD	Urine	Fever 4–5 days	*E. coli*
21	Gobind	23/M	OPD	Urine	Pain in abdomen	*E. coli*
22	Suresh	57/M	OPD	Urine	UTI	*E. coli*
23	Shakuntla	73/F	Medicine ward	Urine	Lower abdomen pain	*E. coli* (cc 10^5 cfu/ml)
24	Damani	22/F	Gynecology OPD	Urine	UTI/Pregnancy	*E. coli* (cc10^4 cfu/ml)
25	Minakshi	24/F	Emergency OPD	Urine	Pain and burn while urination	*E. coli*
26	Malkit Singh	50/M	Medicine ward	Urine	UTI severe with fevers	*E. coli*
27	Kuljeet Kaur	52/F	Emergency ward	Urine	Pain in abdomen	*E. coli*
28	Saka Devi	25/F	Emergency ward	Urine	UTI	*E. coli*
29	Sandhya	25/F	Gynecology ward	Urine	UTI and pain in the lower abdomen	*E. coli* (cc 10^5cfu/ml)
30	Bagh Singh	62/M	Emergency ward	Urine	Burning micturition difficulty in passing urine	*E. coli* (cc 10^4cfu/ml)
31	Preeti	18/F	Labor ward	Urine	pregnancy	*E. coli* (cc 10^5 cfu/ml)
32	Roli	22/F	Gynecology ward	Urine	pregnancy	*E. coli*
33	Geeta Devi	45/F	General OPD	Urine	UTI	*E. coli*
34	Gurdeep	32/M	Ortho ward	Pus	Deep tissue noninvasive proximal tibia	*E. coli* (cc10^5 cfu/ml)
35	Simran	22/F	Med ward	Pus	PTPRM	*E. coli* (cc10^3 cfu/ml)
36	Gudiya	26/F	Medicine OPD	Pus	Incomplete abortion with fever	*E. coli* (cc 10^4 cfu/ml)
37	Pawan	61/M	ICU	Pus	Liver abscess	*E. coli*
38	Delip	16/M	ICU	Pus	Chronic osteomyelitis	*E. coli*

SEX RATIO

These samples were collected from patients at District Hospital, Mohali, Punjab, in this study; the maximum number of patients were females (26) 68.42%, and males (38) 31.57% (Table 2).

Table 2. Graphical representation of the sex ratio

Gender	Frequency	Percentage
Male	12	31.57%
Female	26	68.42%
Total	38	100%

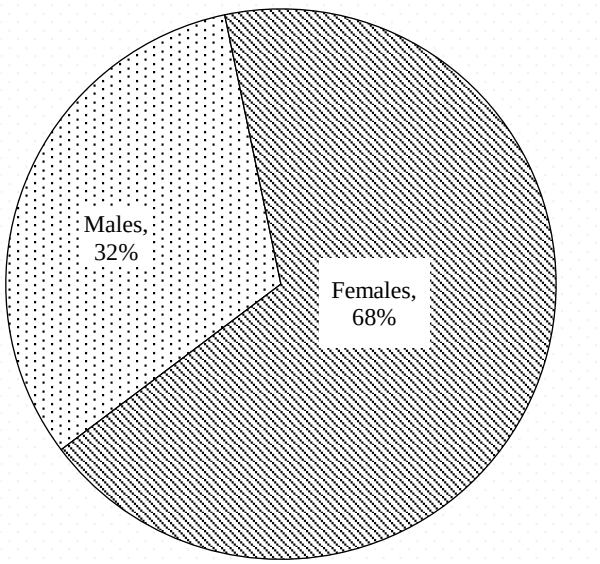

Figure 7. Pie chart representing sex ratio.

Figure 7 (pie chart) shows a graphical representation of the sex ratio of patients with *E. coli***.** The blue color in the pie chart represents the female sex (maximum), and the wine color in the pie chart represents the male sex (minimum).

Age Group

The age group distribution is divided into (n=4) groups. The first group included children (1–12 years), the second group included adolescents (13–17), the third group included adults (18–60) and the last group included older (60–90) (Table 3).

Table 3. Demographic representation of the age group.

Age group	Frequency	Percentage
Children	6	15.38
Adolescent	1	2.56
Adults	28	71.79
Older	4	10.25

Figure 8 shows the age group with the highest number of patients was adults (71.79%), the age group among adolescents was (2.56%), the age group with children was (15.38%) and the last age group with children (10.5%).

Types of Specimens

The collected specimens were distributed into two groups (n=2). This group included urine (86.84 %) and second was pus (15.15 %) (Table 4).

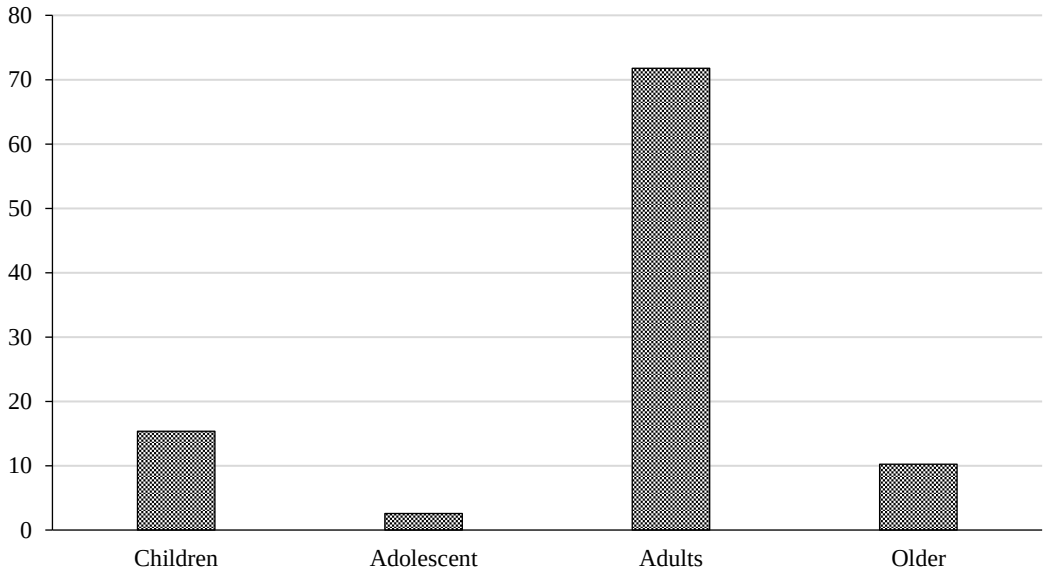

Figure 8. Graphical representation of age distribution.

Table 4. Type of specimen collected.

Type of specimen	Frequency	Percentage
Urine	33	86.84%
Pus	5	15.15%
Total	38	100%

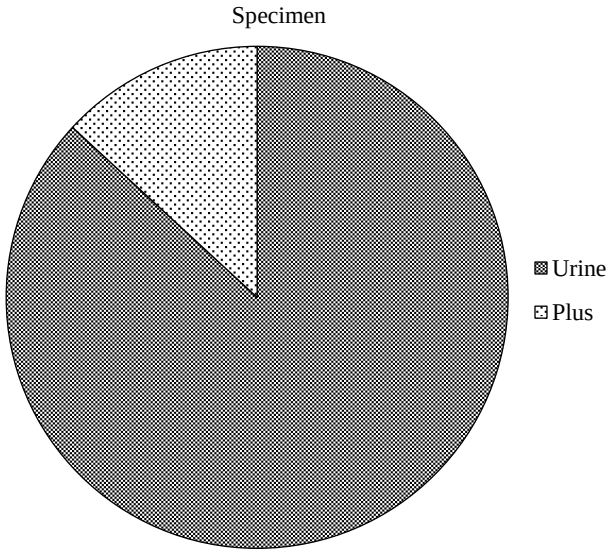

Figure 9. Pie chart representing the type of specimen.

Figure 9 pie chart representing the type of specimen collected with *E. coli*. The blue color represents the urine (maximum) while as green color represents the pus (minimum).

Distribution of Wards

The wards were distributed into (n=13) groups. The groups included ICU (7.89%), Medicine ward (13.15%), Medicine OPD (7.89%), General OPD (2.63%), Orthopedic ward (2.63%), Gynecology ward (10.52%), Labor ward (2.63%), Emergency ward (21%), Emergency OPD (2.63%), OPD (10.54%), Pediatric ward (5.26%), IPD (2.63%), and Gynecology OPD (10.52%) (Table 5).

Table 5. Distribution of wards.

Wards	No. of cases	Percentage
ICU	03	7.89%
Medicine ward	05	13.15%
Medicine OPD	03	7.89%
General OPD	01	2.63%
Orthopedic ward	01	2.63%
Gynecological ward	04	10.52%
Labor ward	01	2.63%
Emergency ward	08	21%
Emergency OPD	01	2.63%
OPD	04	10.54%
Pediatric ward	02	5.26%
IPD	01	2.63%
Gynecological OPD	04	10.52%

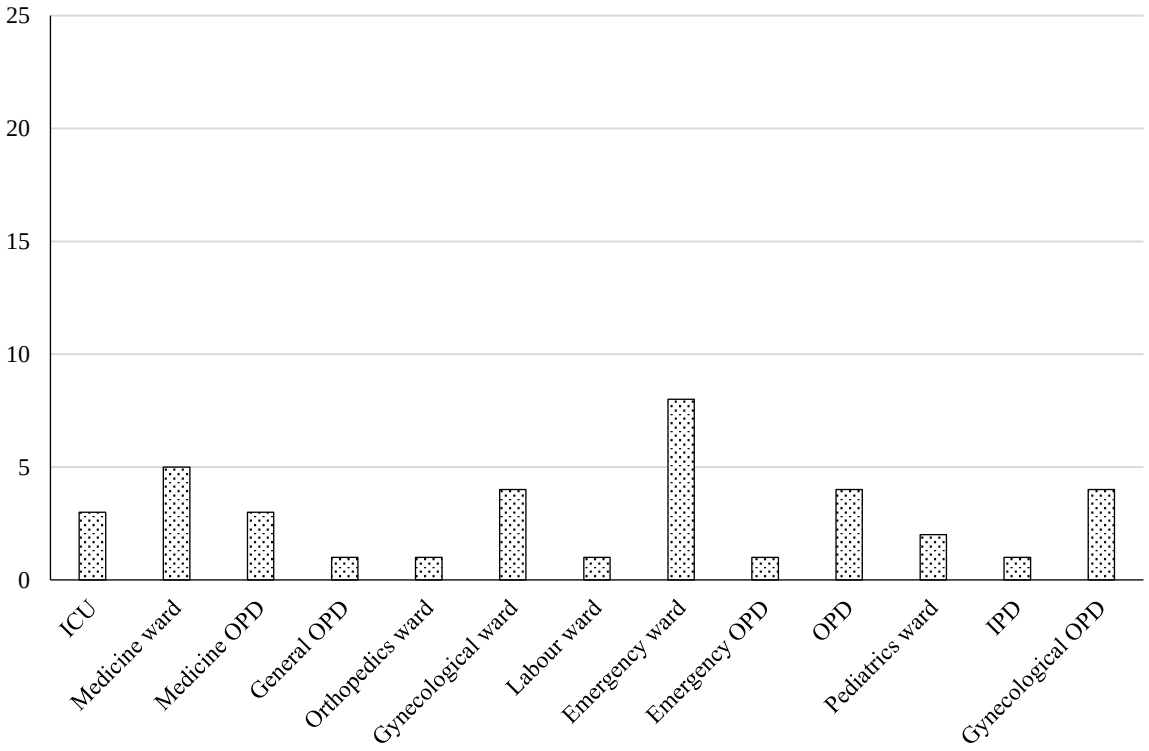

Figure 10. Graphical representation of wards.

Figure 10 shows the distribution of the wards. The highest no. of wards where the patients were admitted was an emergency ward (maximum), whereas the lowest number of wards were general OPD, orthopedics ward, labor ward, emergency OPD, and IPD.

Antimicrobial Susceptibility Test

In the antimicrobial susceptibility test (AST) for *E. coli*, various antibiotics are used to determine which are effective against the bacteria. The results typically indicate whether the strain is susceptible, intermediate, or resistant to each antibiotic, thereby guiding treatment decisions for infections caused by *E. coli* (Table 6).

Table 6. Antimicrobial susceptibility testing of clinical isolates in *E. coli.*

Antibiotics	Resistant	Intermediate	Sensitive
Penicillin	06	10	22
Cefoperazone	15	08	15
Gentamicin	12	03	23
Amikacin	09	05	24
Ampicillin	02	15	21
Clindamycin	04	07	27
Nitrofurantoin	08	12	18
Imipenem	03	10	25
Cotrimoxazole	05	15	18
Ciprofloxacin	02	07	29

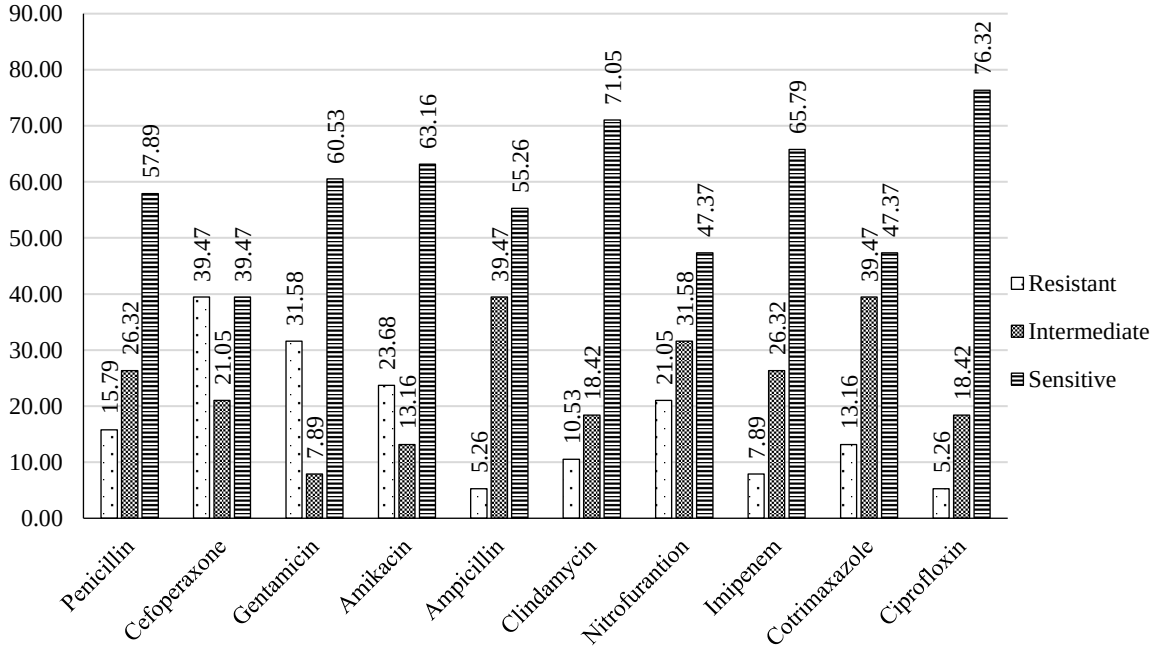

Figure 11. Graph showing antimicrobial susceptibility testing.

Figure 11 shows ciprofloxacin is more sensitive against *E. coli* while cefoperazone is less sensitive against *E. coli*. Cefoperazone is more resistant than ampicillin and ciprofloxacin.

Result

A total of 38 isolates were collected from the District Hospital, Phase 6, Mohali, Punjab.

The study period was 6 months (January 2023 to June 2023). AST was performed using the Kirby–Bauer disk diffusion method.

The highest number of pathogens was isolated from urine (86.84), and a maximum number of patients were admitted to the emergency ward (21%).

Observation

In this study sex ratio was not equal females (68.42%) were more vulnerable to *E. coli* infection than males (31.57%). The maximum age group infected was adults (71.79%), and the minimum age group infected was adolescents (2.56%).

The most resistant antibiotic against the isolates was cefoperazone (39.47%), and the most sensitive was ciprofloxacin (76.31%).

DISCUSSION

The findings of this study shed light on the status of antibiotic susceptibility and resistance of clinically isolated Escherichia coli strains. The prevalence of antibiotic resistance observed in this study raises concerns regarding the effectiveness of conventional antibiotics for treating Escherichia coli infections. These findings highlight the urgent need for alternative treatment strategies and development of new antimicrobial agents.

The analysis of antibiotic susceptibility patterns revealed a diverse range of resistance profiles among clinically isolated Escherichia coli strains. Resistance has been observed across multiple antibiotic classes, including beta-lactams, fluoroquinolones, aminoglycosides, and sulfonamides. The high prevalence of resistance, particularly to commonly prescribed antibiotics, indicates the need for cautious antibiotic selection and personalized treatment approaches.

The emergence of multidrug-resistant strains is a significant finding of this study. Resistance to multiple antibiotics in a single strain poses challenges in clinical management, as it limits the available treatment options. Multidrug resistance patterns can be linked to the uptake of resistance genes via horizontal gene transfer mechanisms, including plasmids or transposons. These mobile genetic components are pivotal in spreading resistance throughout bacterial communities.

Thus, the clinical implications of antibiotic resistance in Escherichia coli infections are significant. Patients infected with antibiotic-resistant strains often experience worse treatment outcomes, including prolonged hospital stay, increased morbidity, and higher mortality rates. Limited treatment options for multidrug-resistant strains may result in delayed or inadequate therapy, leading to unfavorable clinical outcomes. These findings underscore the significance of promptly and precisely identifying resistance patterns to inform suitable treatment choices.

CONCLUSION

In conclusion, this project has advanced our understanding of antibiotic susceptibility in clinically isolated Escherichia coli strains and provides evidence-based insights for the management and control of antibiotic-resistant infections. We hope that the outcomes of this project will contribute to the development of strategies to mitigate the impact of antibiotic resistance and ultimately improve patient outcomes in the face of bacterial infections caused by Escherichia coli.

The results and suggestions of this project have substantial implications for both clinical practice and public health. By understanding antibiotic susceptibility patterns and resistance mechanisms, healthcare providers can make informed decisions regarding antibiotic therapy, implement appropriate infection control measures, and contribute to efforts to reduce the development and spread of antibiotic resistance.

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