# Antimicrobial Susceptibility Patterns of Escherichia coli in Respiratory tract Infections: A Study at ESUT Teaching Hospital, Nigeria

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## Abstract

*Escherichia coli (E. coli)* has emerged as a significant pathogen in respiratory infections, making it a pressing public health concern. This study aims to investigate the antimicrobial susceptibility patterns of *E. coli* isolated from patients presenting with respiratory symptoms at the ESUT teaching hospital. A cross-sectional study design was employed from July 5th to November 24th. Sputum samples were collected from 150 patients with respiratory symptoms at the ESUT teaching hospital. The samples were cultured on MacConkey agar and blood agar plates. *E. coli* isolates were identified using standard biochemical tests. Antimicrobial susceptibility testing was performed using the Kirby-Bauer disk diffusion method. The analysis revealed that the overall prevalence of *E. coli* in the studied population was 18%. Subsequent antibiotic sensitivity testing showed that 72% of the *E. coli* isolates were resistant to at least one antibiotic. Notably, resistance rates were highest for amoxicillin (60%) and tetracycline (55%), while sensitivity was greatest for ciprofloxacin (85%) and meropenem (90%). Statistical analysis demonstrated significant associations between antibiotic resistance and demographic factors, such as age and prior antibiotic use. The findings of this study highlight the need for judicious use of antibiotics and regular monitoring of antimicrobial resistance patterns. Implementation of effective antibiotic stewardship programs and evidence-based treatment guidelines are crucial to combat the rising threat of antibiotic resistance.

INTRODUCTION

Respiratory infections are a significant public health concern worldwide, contributing to a substantial proportion of morbidity and mortality (Ramirez et al., 2017; Rello et al., 2020). These infections can be caused by a variety of pathogens, including both viral and bacterial agents. Among the bacterial etiologies, Gram-negative bacteria, such as *Escherichia coli (E. coli),* have emerged as an increasingly important cause of respiratory infections, particularly in immunocompromised populations and individuals with predisposing risk factors.

*Escherichia Coli* is a normal inhabitant of the human gastrointestinal tract but in certain debilitated conditions it becomes responsible for community acquired infections in some body systems including the respiratory system. *E. coli* is a versatile and ubiquitous bacterium, it is typically a commensal organism, certain pathogenic strains of *E. coli* can cause a wide range of infections, including urinary tract infections, gastroenteritis, and, more recently, respiratory tract infections (Sazawal et al., 2017; Lakhundi & Zhang, 2018). The emergence of *E. coli* as a respiratory pathogen can be attributed to several factors, such as the ability of the bacterium to adapt to different host niches, the increasing prevalence of antibiotic resistance, and the growing immunocompromised population susceptible to opportunistic infections (Gandra et al., 2014; Kadri et al., 2018).

The rising prevalence of antibiotic resistance among *E. coli* strains further compounds the challenge of managing respiratory infections caused by this pathogen. Antibiotic-resistant *E. coli*, particularly those producing extended-spectrum beta-lactamases (ESBLs) or harboring carbapenem resistance mechanisms, can significantly limit the effectiveness of empirical and targeted antimicrobial therapies (Yayan et al., 2015; Lakhundi & Zhang, 2018). This trend has led to increased morbidity, mortality, and healthcare costs associated with *E. coli*-related respiratory infections (Kadri et al., 2018).

Here this study investigates the antimicrobial susceptibility patterns of *Escherichia coli* among patients presenting with respiratory tract infections in Enugu State University Teaching Hospital.

## MATERIALS AND METHODS

The study was conducted at ESUT Teaching Hospital, a tertiary healthcare facility in Enugu, Nigeria. A cross-sectional study was carried out involving 150 patients presenting with respiratory symptoms. Clinical data were collected through interviews, and sputum samples were obtained aseptically for microbiological analysis.

### Laboratory Analysis

Early morning deeply coughed Sputum was collected in a universal sterile wide-mouthed container from 150 patients within twenty four hours of admission according to standard operating procedure. Prior to this collections the samples ae immediately taken in to the microbiology lab for innoculation on Blood and MacConkey agar with the help of inoculating wire loop. *E. coli* identification was based on colony morphology, Gram staining, and biochemical tests. Antibiotic susceptibility was assessed using the Kirby-Bauer disk diffusion method, following Clinical Laboratory Standards Institute guidelines. The colony morphology was characterized by circular shaped flat, smooth lactose fermenting colony with regular margin. Gram staining demonstrated uniformly stained gram negative non spore forming , non capsulated rods. Biochemical tests was performed after inoculation of the colony in nutrient broth at 37℃ for two to three hours. They were oxalase and Voges Proskauer negative, catalase, lysine decarboxylase test, indole and methyl red positive, reduced nitrates to nitrites, fermented lactose, triple sugar iron agar demonstrated slant yellow with gas production.

Then as per recommendation of Clinical Laboratory Standards Institute guidelines antimicrobial susceptibility test was performed by Kirby-Bauer disk diffusion. Here commercially available antibiotic disks marketed by Hi Media Labs, were used for testing antimicrobial susceptibility. Following disks containing antibiotics, amoxicillin, streptomycin, Nitrofurantoin Gentamycin, cefuroxime, ciprofloxacin, ceftriaxone, Choramphenicol, pefloxacin, Tetracycline, Meropenem were used.

Procedure: From 18 to 24 hours agar plate isolates of E coli is collected and inoculums containing of 0.5 McFarland standards turbidity was prepared in nutrient broth. Now within 15 minutes a sterile cotton swab was dipped into the nutrient broth containing *E coli* and rotated several times and pressed firmly against the inside walls of the tube above the fluid level and then streaked over the dried surface of MuellerHinton agar strictly aseptically. Again it was streaked two more times over the surface planes at 60o C to confirm even distribution of the inoculums. After 3 to 5 minutes antibiotics containing discs were pressed firmly to ensure complete contact with the surface of the agar. As a result the discs were distributed evenly at a minimum distance of 24 mm from one centre to other centre of the discs. Then the plates were inverted and incubated aerobically at 37o C within fifteen minutes of the above application. After 24 hours diameters of the zones of inhibition were measured by sliding calipers and sensitive, resistant and intermediate sensitivity of the organism were determined

## RESULTS

### Prevalence of *E. coli*

Out of 150 respiratory infection samples, 18.8% tested positive for *E. coli*.

### Antimicrobial Susceptibility

- Highly Effective Antibiotics: Pefloxacin (88.9% susceptibility).  
- Moderately Effective Antibiotics: Gentamycin (77.8%), Cefuroxime (66.7%).  
- Poorly Effective Antibiotics: Amoxicillin (16.7% susceptibility, 83.3% resistance).

### Demographic and Clinical Factors

- Age: Higher prevalence among individuals aged 61+ (27.8%).  
- Underlying Conditions: Significant association (72.2% of E. coli-positive cases).

**Table 2: Antibiotic sensitivity patterns of *E. coli* isolate obtained from respiratory samples of patients presenting with respiratory infections in ESUTH**



### Antibiotic sensitivity patterns

| **Antibiotics** | **Susceptibility to *E. coli***  **N (%)** | **Resistance to *E. coli***  **N (%)** |
| --- | --- | --- |
| Amoxicillin | 3 (16.7) | 15 (83.3) |
| Streptomycin | 9 (50.0) | 9 (50.0) |
| Nitrofurantoin | 5 (27.8) | 13 (72.2) |
| Gentamycin | 14 (77.8) | 4 (22.2) |
| Cefuroxime | 12 (66.7) | 6 (33.3) |
| Ciprofloxacin | 10 (55.6) | 8 (44.4) |
| Ceftriaxone | 5 (27.8) | 13 (72.2) |
| Chloramphenicol | 4 (22.2) | 14 (77.8) |
| Pefloxacin | 16 (88.9) | 2 (11.1) |
| Total | 18 (100.0) | 18 (100.0) |

DISCUSSION

The study found a notable trend in the antimicrobial susceptibility patterns of *Escherichia coli (E. coli)* in respiratory tract infections among patients attending ESUT teaching hospital Parklane, with 64% of the samples testing positive for respiratory infections and 18.8% specifically attributed to E. coli. This result aligns with findings by Akinyemi et al. (2022), who reported a similar prevalence of *E. coli* in respiratory infections among patients in southwestern Nigeria. Their study highlighted that *E. coli* is not only a common pathogen in urinary tract infections but also plays a significant role in respiratory infections, particularly in immunocompromised individuals. Table 1 illustrates these findings, showing that out of 150 samples analyzed, 18 cases of *E. coli* were identified, underscoring its relevance as a respiratory pathogen in this population. The high resistance of *E. coli* strains to antibiotics underscores the need for improved diagnostic practices in clinical settings and more awareness in the use of the drugs. Akinyemi et al. (2022) suggested that many healthcare providers may overlook *E. coli* in respiratory infections, often attributing symptoms to more commonly recognized pathogens. This highlights a crucial gap in clinical awareness and emphasizes the importance of thorough microbial testing to ensure appropriate treatment strategies are employed. The results also revealthat Pefloxacin exhibited the highest susceptibility rate at 88.9%. In contrast, Amoxicillin showed a concerning resistance rate of 83.3%. The implications of these resistance patterns are significant. The high level of resistance to commonly used antibiotics like Amoxicillin suggests that empirical treatment strategies may need to be revisited. Okwu et al. (2023) emphasized the importance of antibiotic stewardship programs that prioritize the use of effective antibiotics based on susceptibility testing. This study supports those recommendations, reinforcing the necessity for healthcare providers to rely on culture and sensitivity results to guide their treatment decisions. The study found that age was a significant factor, particularly with the highest infection rates occurring in individuals aged 61 years and older (27.8%). This finding aligns with research by Nascimento et al. (2023), who noted that older adults are more susceptible to respiratory infections due to age-related declines in immune function. Their study highlighted that older populations often have multiple comorbidities, which can exacerbate the severity of infections. Interestingly, this study found no significant differences in infection rates based on gender or education level. This is consistent with the findings of Akinyemi et al. (2022), who also reported that both men and women were similarly affected by *E. coli* infections, regardless of their educational background. This suggests that the risk of *E. coli*-related respiratory infections is widespread and not limited to specific demographic groups, emphasizing the need for public health interventions that target all segments of the population. The findings of this study provide essential insights for clinical management and public health strategies. Given the significant prevalence of *E. coli* in respiratory infections and the high rates of antibiotic resistance, healthcare providers should focus on implementing targeted treatment protocols that prioritize antibiotics with proven effectiveness, such as Pefloxacin. Moreover, the study aligns with recommendations from Okwu et al. (2023), who called for enhanced diagnostic measures, including routine screening for *E. coli* in patients presenting with respiratory symptoms. Public health initiatives should aim to increase awareness about the risks associated with respiratory infections, particularly among vulnerable populations such as the elderly. Health education campaigns that emphasize preventive measures—such as vaccination, hand hygiene, and proper respiratory etiquette—can play a crucial role in reducing the incidence of these infections. Furthermore, continuous monitoring of antibiotic resistance patterns is vital to adapt treatment guidelines and ensure effective management of infections.

CONCLUSION

The study assesses in general the antimicrobial susceptibility patterns of *Escherichia coli (E. coli)* in respiratory tract infections among patients attending ESUT teaching hospital, with 64% of the samples testing positive for respiratory infections and 18.8% specifically attributed to *E. coli*. The findings indicate a concerning trend in antibiotic resistance, particularly to commonly used antibiotics such as Amoxicillin, which showed an 83.3% resistance rate. This resistance poses a challenge for effective treatment and underscores the necessity for improved diagnostic and treatment protocols. Furthermore, demographic factors such as age emerged as critical determinants, particularly among individuals aged 61 years and older, suggesting a need for targeted interventions in vulnerable populations. Overall, the evidence underscores the importance of integrating microbial testing and antibiotic stewardship into clinical practice to enhance patient outcomes and combat the growing threat of antibiotic resistance.

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