

Identification, Speciation and Antibigram of Urinary Pathogens from Hospitalized Patients at Tertiary Care Hospital

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Abstract: ***Background:** Urinary tract infections (UTIs) are a major cause of morbidity in hospitalized patients and are increasingly associated with multidrug-resistant (MDR) organisms. Institution-specific data are essential for guiding empiric therapy. **Objectives:** To identify urinary pathogens and determine their antibiotic susceptibility patterns in admitted patients with suspected UTIs. **Methods:** This prospective observational study was conducted over six months, processing 421 urine samples using standard microbiological techniques. Identification was done by culture and biochemical methods, and antibiotic susceptibility testing was performed using the Kirby-Bauer method and VITEK system as per CLSI guidelines. Data were analyzed using descriptive statistics and Chi-square test. **Results:** Significant growth was observed in 63% of samples. Escherichia coli (52%) was the predominant isolate, followed by Klebsiella pneumoniae (21%), Pseudomonas aeruginosa (8%), Acinetobacter spp. (7%), Enterococcus spp. (8%), and Candida spp. (4%). High resistance to fluoroquinolones and cephalosporins was noted among Gram-negative isolates, while sensitivity to nitrofurantoin, carbapenems, and colistin remained effective. Over 50% of isolates were MDR, with ESBL production in 42% of E. coli and 48% of Klebsiella. **Conclusion:** Rising MDR and ESBL rates highlight the need for regular antibiograms and antimicrobial stewardship.*

Keywords: Urinary tract infection, Uropathogens, Antibiogram, Multidrug resistance, ESBL

1. Introduction

Urinary tract infections (UTIs) represent one of the most frequent bacterial infections globally and continue to be a leading cause of morbidity in both community and hospital settings. In India, the burden of UTIs is particularly significant in tertiary care hospitals, where a large proportion of cases involve admitted patients with risk factors such as catheterization, prolonged hospital stays, immunosuppression, and prior antibiotic exposure. These conditions not only increase susceptibility to infection but also drive the emergence of multidrug-resistant (MDR) organisms, making treatment more challenging [1].

2. Literature Survey

The etiological spectrum of UTIs is dominated by Gram-negative bacteria, with Escherichia coli consistently identified as the most prevalent pathogen, followed by Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter species. Gram-positive cocci, particularly Enterococcus spp., also contribute significantly to nosocomial UTIs. However, the relative distribution of pathogens varies considerably across regions, healthcare facilities, and patient populations in India. For example,

studies from different parts of the country demonstrate that while E. coli predominates in community-acquired infections, Klebsiella and non-fermenting Gram-negative bacilli are more common in hospital-acquired cases, especially in intensive care units [2,3].

Antimicrobial resistance (AMR) is now a major global health concern, with India recognized as one of the epicenters due to widespread and often inappropriate antibiotic use. Uropathogens in tertiary care hospitals are increasingly resistant to commonly prescribed agents such as fluoroquinolones, cotrimoxazole, and third-generation cephalosporins. The widespread occurrence of extended-spectrum β -lactamase (ESBL)-producing Enterobacterales has severely compromised the efficacy of cephalosporins, forcing reliance on carbapenems and aminoglycosides as last-line options [4]. Unfortunately, resistance to carbapenems, driven by carbapenemase-producing strains, has also been reported in UTI isolates, raising concerns about limited therapeutic choices [5].

Recent multicentric surveillance across India has highlighted striking regional variations in antimicrobial susceptibility. In some centers, nitrofurantoin and fosfomycin have retained high activity against E. coli, especially in community-acquired infections, while in others resistance is steadily rising. Such variability underscores the necessity for

institution-specific antibiograms to guide empiric therapy rather than relying on national-level data [6]. Inpatients admitted to tertiary hospitals are often prescribed broad-spectrum antimicrobials empirically before culture results are available, which contributes further to resistance selection. Therefore, regular monitoring of local resistance trends through systematic antibiogram generation is critical to optimize antibiotic stewardship [7].

Catheter-associated urinary tract infections (CAUTIs) constitute a significant proportion of hospital-acquired UTIs in tertiary care settings. The use of indwelling urinary catheters disrupts host defenses and facilitates colonization by MDR organisms, including *Pseudomonas*, *Acinetobacter*, and *Enterococcus* species. Studies from Indian ICUs demonstrate that CAUTIs are often polymicrobial and are associated with prolonged hospitalization and increased healthcare costs [8]. Preventive strategies, such as catheter care bundles, strict hand hygiene, and minimization of catheter use, remain essential, but surveillance of causative organisms and their resistance profiles is equally vital to guide empiric therapy in critically ill patients.

The clinical consequences of rising resistance among uropathogens include delayed initiation of effective therapy, increased treatment failures, prolonged hospital stays, and higher healthcare costs. For example, MDR *E. coli* and *Klebsiella* strains have been reported to exhibit resistance rates exceeding 50% for cephalosporins and fluoroquinolones, with reduced susceptibility even to aminoglycosides and piperacillin-tazobactam in some regions [9]. This necessitates the use of carbapenems or colistin in severe cases, both of which are costly, associated with significant toxicity, and risk becoming ineffective if misuse continues.

The accurate identification and speciation of uropathogens is a cornerstone for both clinical management and infection control. Advanced laboratory methods, including automated culture systems and molecular detection of resistance genes, complement traditional culture and sensitivity testing to improve turnaround times and accuracy. In tertiary care hospitals, where patient profiles are heterogeneous and include immunocompromised hosts, transplant recipients, and ICU patients, such precision in microbial diagnosis is crucial [10].

The present study on “Identification, Speciation and Antibiogram of Urinary Pathogens from Admitted Patients at a Tertiary Care Hospital” is highly relevant, as it generates updated local data on pathogen distribution and resistance trends to guide empirical therapy, refine antibiotic policies, and support stewardship. With rising MDR, ESBL, and carbapenem-resistant strains complicating treatment, such institution-specific studies are crucial for rational prescribing, timely de-escalation, improved patient outcomes, and curbing the spread of antimicrobial resistance.

Problem definition:

The aim of this study was to identify, speciate, and assess the antimicrobial susceptibility patterns of urinary pathogens in admitted patients at a tertiary care hospital, to provide updated local data for guiding empirical therapy and antibiotic stewardship.

3. Materials and Methods

A prospective, cross-sectional study conducted for over 6 month period at Ballari Medical College & Research Centre, Ballari (formerly known as Vijayanagar Institute of Medical Sciences (VIMS)).

The sample size was calculated as 366 using prevalence 39.3%, $Z = 1.96$, and $d = 0.05$. With a 15% buffer, the final target was 421 samples.

Admitted patients of all ages and genders with suspected UTI, providing midstream or catheter urine samples with consent, were included. Patients with recent antibiotic use, improper samples, incomplete data, or refusal of consent were excluded.

Consecutive eligible sampling was used, enrolling all admitted patients meeting criteria during the study period. Urine was collected under aseptic conditions as midstream or catheter samples.

Urine samples underwent macroscopic and microscopic examination, culture on Blood and MacConkey agar, species identification was performed using biochemical tests, and antibiotic susceptibility testing using Kirby–Bauer disc diffusion as per CLSI.

Isolates were grouped as Gram-negative, Gram-positive, or fungal pathogens, with further categorization by species, ward/ICU location, and catheter status.

Demographic, clinical, and laboratory findings were recorded in a predesigned proforma and entered in Microsoft Excel, with confidentiality maintained by unique codes.

Primary parameters included identification, speciation, and antibiogram results. Secondary parameters assessed distribution across age, gender, catheterization, and ICU versus ward patients.

Data were analyzed using Excel and SPSS. Frequencies and percentages were calculated, and Chi-square tests compared resistance patterns across groups, with $p < 0.05$ was considered statistically significant.

Ethical approval was obtained from the Institutional Ethics Committee. Written informed consent was taken, patient confidentiality maintained, and all laboratory work conducted with biosafety precautions.

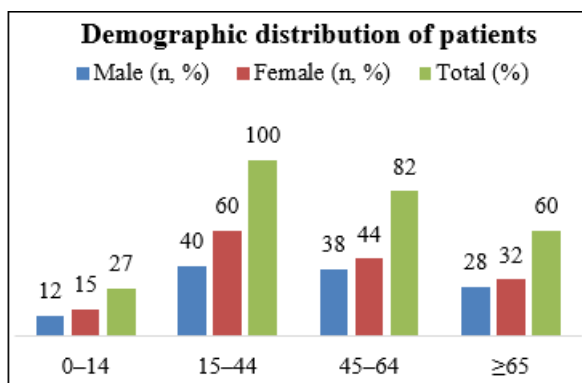
4. Results

1) Demographic distribution of patients

Most admitted patients with suspected UTI were adults, with females slightly outnumbering males, reflecting the known higher risk of UTIs among women (Table 1).

Table 1: Age and sex distribution of study participants

Age group (years)	Male (n, %)	Female (n, %)	Total (%)
0–14	12 (8)	15 (10)	27 (9)
15–44	40 (26)	60 (39)	100 (33)
45–64	38 (25)	44 (28)	82 (27)
≥65	28 (18)	32 (21)	60 (20)
Total	118 (39)	151 (61)	269 (100)



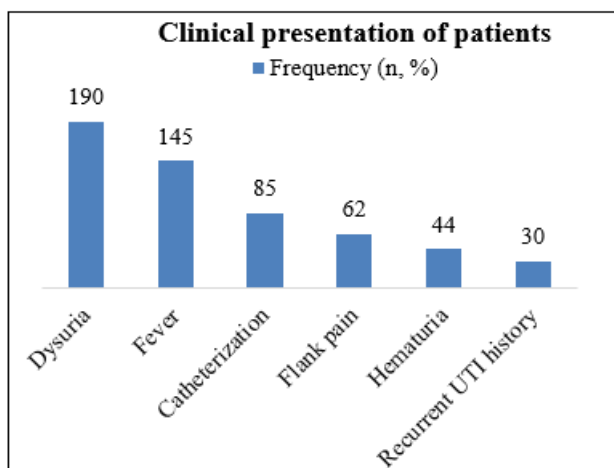
Graph 1: Age and Gender distribution of patients

2) Clinical presentation of patients

Dysuria and fever were the most frequent symptoms, while catheterization was a common risk factor among inpatients (Table 2).

Table 2: Clinical profile of admitted patients with suspected UTI

Clinical Feature	Frequency (n, %)
Dysuria	190 (63)
Fever	145 (48)
Catheterization	85 (28)
Flank pain	62 (21)
Hematuria	44 (15)
Recurrent UTI history	30 (10)



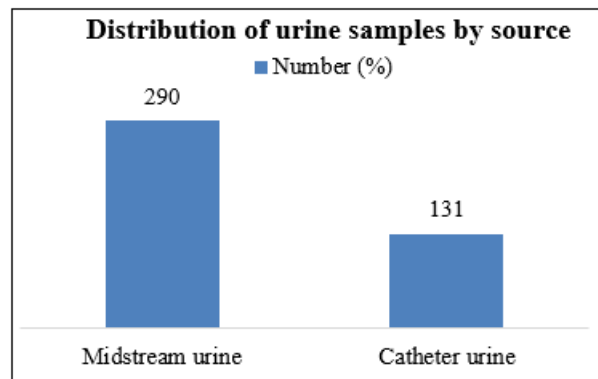
Graph 2: Clinical profile of admitted patients with suspected UTI

3) Distribution of urine samples by source

Most samples were midstream urine, though catheter samples accounted for nearly one-third of cases (Table 3).

Table 3: Source of urine samples

Sample type	Number (%)
Midstream urine	290 (68)
Catheter urine	131 (32)
Total	421 (100)



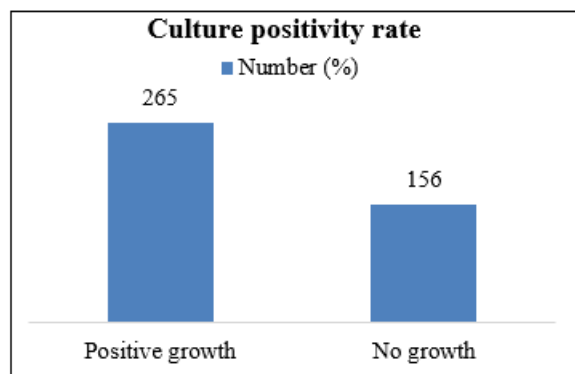
Graph 3: Distribution of samples by source

4) Culture positivity rate

Overall, 63% of urine samples yielded significant bacterial or fungal growth, while the remainder were sterile (Table 4).

Table 4: Culture positivity among collected samples

Culture result	Number (%)
Positive growth	265 (63)
No growth	156 (37)
Total	421 (100)



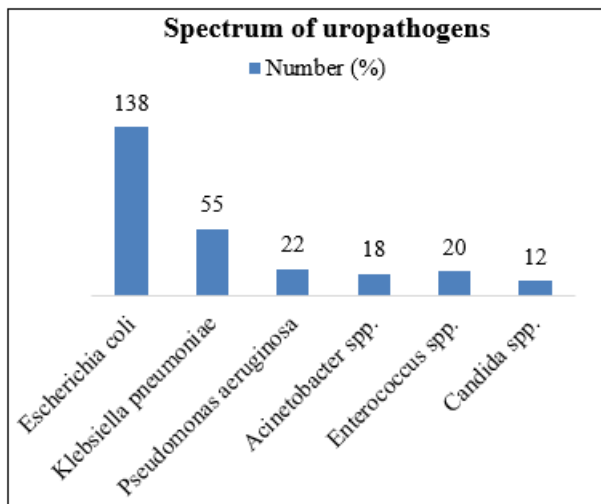
Graph 4: Culture positivity among collected samples

5) Spectrum of uropathogens

E. coli was the predominant isolate, followed by *Klebsiella pneumoniae*, with non-fermenters and *Enterococcus* also notable (Table 5).

Table 5: Distribution of isolated uropathogens

Pathogen	Number (%)
<i>Escherichia coli</i>	138 (52)
<i>Klebsiella pneumoniae</i>	55 (21)
<i>Pseudomonas aeruginosa</i>	22 (8)
<i>Acinetobacter spp.</i>	18 (7)
<i>Enterococcus spp.</i>	20 (8)
<i>Candida spp.</i>	12 (4)
Total	265 (100)



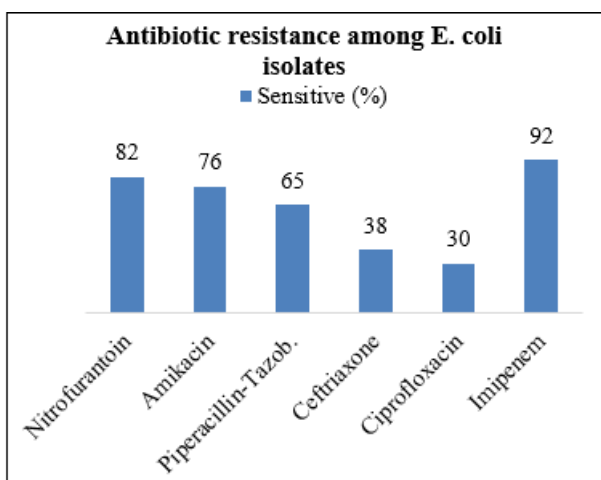
Graph 5: Distribution of isolated uropathogens

6) Antibiotic resistance among E. coli isolates

High resistance was observed against fluoroquinolones and third-generation cephalosporins, with better susceptibility to nitrofurantoin and carbapenems (Table 6).

Table 6: Antibiotic susceptibility pattern of E. coli

Antibiotic	Sensitive (%)
Nitrofurantoin	82
Amikacin	76
Piperacillin-Tazobactam	65
Ceftriaxone	38
Ciprofloxacin	30
Imipenem	92



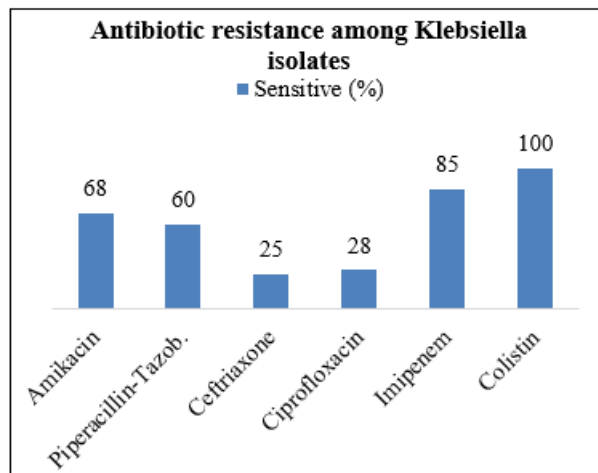
Graph 6: Antibiotic susceptibility pattern of E. coli

7) Antibiotic resistance among Klebsiella isolates

K. pneumoniae isolates showed widespread resistance, particularly to cephalosporins, though carbapenems retained high activity (Table 7).

Table 7: Antibiotic susceptibility pattern of K. pneumoniae

Antibiotic	Sensitive (%)
Amikacin	68
Piperacillin-Tazobactam	60
Ceftriaxone	25
Ciprofloxacin	28
Imipenem	85
Colistin	100



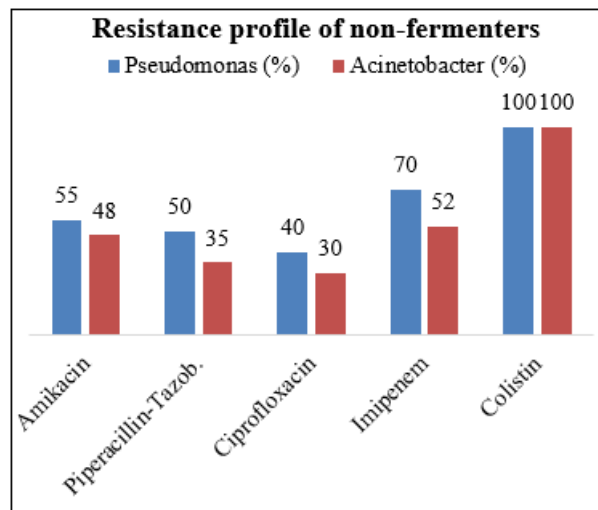
Graph 7: Antibiotic susceptibility pattern of K. pneumoniae

8) Resistance profile of non-fermenters

Pseudomonas and Acinetobacter displayed multidrug resistance, with susceptibility largely limited to colistin and some aminoglycosides (Table 8).

Table 8: Susceptibility of non-fermenting Gram-negative bacilli

Antibiotic	Pseudomonas sensitivity (%)	Acinetobacter sensitivity (%)
Amikacin	55	48
Piperacillin-Tazob.	50	35
Ciprofloxacin	40	30
Imipenem	70	52
Colistin	100	100



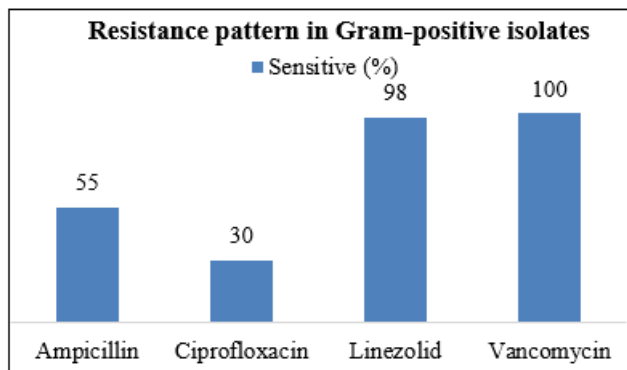
Graph 8: Susceptibility of non-fermenting Gram-negative bacilli

9) Resistance pattern in Gram-positive isolates

Enterococcus isolates showed notable resistance to fluoroquinolones, while vancomycin resistance was absent (Table 9).

Table 9: Antibiotic susceptibility of Enterococcus spp.

Antibiotic	Sensitive (%)
Ampicillin	55
Ciprofloxacin	30
Linezolid	98
Vancomycin	100



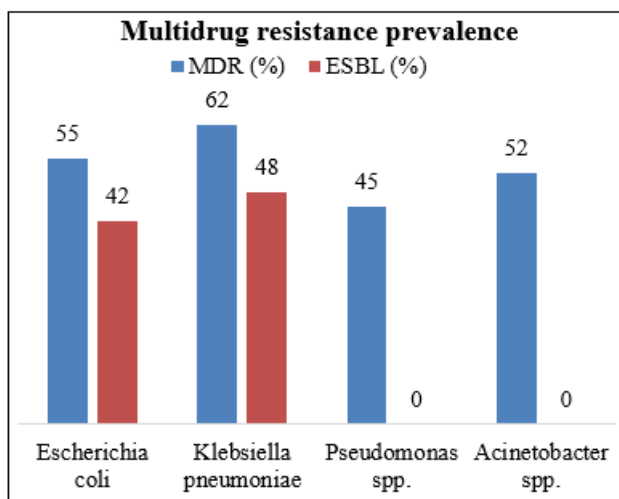
Graph 9: Antibiotic susceptibility of *Enterococcus* spp.

10) Multidrug resistance prevalence

More than half of Gram-negative isolates were multidrug resistant, with ESBL production common in *E. coli* and *Klebsiella* (Table 10).

Table 10: Prevalence of MDR and ESBL isolates

Pathogen	MDR (%)	ESBL (%)
<i>Escherichia coli</i>	55	42
<i>Klebsiella pneumoniae</i>	62	48
<i>Pseudomonas</i> spp.	45	0
<i>Acinetobacter</i> spp.	52	0



Graph 10: Prevalence of MDR and ESBL isolates

5. Discussion

In the present study, adults formed the majority of admitted patients with suspected UTIs, with a clear female predominance (61%). This finding is in line with Choudhary et al. [4] and Bhargava et al. [3], who also reported higher UTI prevalence among women, attributable to anatomical and hormonal factors. Clinical manifestations were dominated by dysuria and fever, with catheterization seen in nearly one-third of cases. Similar risk associations were highlighted by Parihar et al. [7], who identified catheterization as a major contributor to nosocomial UTIs in ICUs.

Most samples were obtained as midstream urine, though catheter specimens comprised 32%, which is comparable to Kashyap et al. [5], who also reported a high proportion of catheter-associated samples. Culture positivity in our cohort was 63%, closely resembling Tomy et al. [6], who

documented 62% positivity in a South Indian tertiary-care hospital.

Escherichia coli was the most common isolate (52%), followed by *Klebsiella pneumoniae* (21%), with non-fermenters and *Enterococcus* contributing significantly. These results parallel those of Bhargava et al. [3] and Choudhary et al. [4], who observed *E. coli* as the dominant uropathogen, though non-fermenters were increasingly represented in hospital settings.

Antibiotic susceptibility patterns showed high resistance of *E. coli* to fluoroquinolones and cephalosporins, but good activity of nitrofurantoin (82%) and carbapenems (92%). Rizvi et al. [1] also reported over 65% ciprofloxacin resistance but preserved nitrofurantoin efficacy. *K. pneumoniae* isolates were highly resistant to cephalosporins but remained sensitive to carbapenems and colistin, consistent with Mohapatra et al. [2]. Non-fermenters such as *Pseudomonas* and *Acinetobacter* demonstrated multidrug resistance with reliable sensitivity only to colistin, as previously observed by Kashyap et al. [5].

Among Gram-positive isolates, *Enterococcus* species exhibited fluoroquinolone resistance but retained full susceptibility to vancomycin and high linezolid sensitivity, findings comparable to Pelluri et al. [10]. Importantly, more than half of Gram-negative isolates were multidrug resistant, with ESBL production frequent in *E. coli* (42%) and *Klebsiella* (48%). Tomy et al. [6] similarly documented ESBL prevalence exceeding 40%, reinforcing concerns over empirical cephalosporin use.

Overall, our results reaffirm the predominance of *E. coli* while emphasizing the growing burden of multidrug-resistant organisms in hospitalized patients. Preserved efficacy of nitrofurantoin, carbapenems, and colistin highlights their role as essential therapeutic options, while the findings strongly support the need for regular hospital antibiograms and robust antimicrobial stewardship practices.

6. Conclusion

The present study emphasizes *Escherichia coli* as the predominant uropathogen in admitted patients, followed by *Klebsiella* and non-fermenters, with a high prevalence of multidrug resistance and ESBL production. Resistance to fluoroquinolones and cephalosporins was widespread, while nitrofurantoin, carbapenems, and colistin retained good efficacy. *Enterococcus* isolates remained susceptible to vancomycin and linezolid. These findings emphasize the urgent need for regular institution-specific antibiograms, judicious antibiotic use, and strong stewardship policies to optimize empiric therapy, reduce resistance, and improve patient outcomes.

Author Contributions

Dr. Aqib Ali: Conceptualization, study design, sample and data collection, microbiological processing, data analysis, manuscript drafting.

Dr. Narayana Srihari: Supervision, review of methodology, manuscript editing, and final approval of the version to be published.

Dr. Mariraj Jeer: Critical revision of the manuscript, and final approval of the version to be published.

Dr. Kumudini: Contributed to result interpretation and discussion writing.

Dr Haafiza Begum: Manuscript editing.

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