



## Research Article

# Antibiotic sensitivity of catheter-associated bacterial pathogens in pediatrics patients

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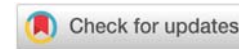
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**Keywords:** Antibiogram; Cather-associated bacteria; Urinary tract infection; Antibiotic resistance

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## Abstract

Antimicrobial-resistant (AMR) pathogens causing Urinary Tract infection is a serious public health concern in our clinical setting. A total of 200 catheter tips were collected from the different wards (medical, surgical, urology) at the Children's Hospital Faisalabad. Samples were streaked on nutrient agar plates and the positivity of the samples was noted after 24 hours. Positive samples were processed further for the identification of *K. pneumoniae*, *P. aeruginosa*, *S. aureus*, and *E. coli* using culture identification, microscopy, and biochemical profiling on the basis of culture characterization, microscopy, biochemical profiling, and antibiotic susceptibility testing. 76 (38%) of the samples showed growth on nutrient agar. In processed samples, the high prevalence was marked for *P. aeruginosa* (24/200; 12%) followed by *E. coli* (22/200; 11%) and *S. aureus* (19/200; 9.5%) while 11 *K. pneumoniae* isolates (5.5%) were identified in this study. In antibiotic susceptibility profiling of *P. aeruginosa*, the highest susceptibility was found for colistin (100%) and imipenem (70.83%) followed by gentamicin (54.17%) while the highest resistance was found for tobramycin (54.17%) followed by meropenem, ceftazidime, and cefotaxime (50%).

**Conclusion:** Advance studies are needed to investigate the real investigations of bacterial contamination; resistance to treatment options and resistance to antibiotics are needed.

## Background

In children, urinary tract infection (UTI) is the most prevalent bacterial infection, within the first seven years of life affecting 8% & 2% of girls and boys respectively [1]. Abnormalities of urinary tract abnormalities like congenital can cause a high risk of UTI in some children [2]. In 30% of children with CAKUT (congenital anomalies of kidney and urinary tract) are at danger for the development of UTI in children. Unidirectional flow of urine changes due to vesico-ureteral reflux (VUR) [3], while pyelo-ureteral junction obstruction (PUJO) leads to stasis, in which both increase the risk of multiplying pathogenic microorganisms [4]. At the age of 1 month and 11 years, more than 8% of children will experience at least one UTI, and during the first six to 12 months after an

initial UTI, more than 30% of kids and newborns experience repetitive infections [5]. The most common etiology of UTIs is due to more than 95% of bacteria. *Escherichia coli* (*E. coli*) is the most frequent causative organism of UTIs and it is responsible for more than 80% of UTIs [6]. In males *Proteus mirabilis* is more frequent than in females while in newborn infants *Streptococcus agalactiae* is more common, *Streptococcus viridians*, *Haemophilus influenza*, *Streptococcus pneumonia*, *Staphylococcus epidermidis*, *Staphylococcus aureus*, and *Streptococcus agalactia* may be responsible in children with anomalies of the urinary tract (anatomic, neurologic, or functional) or compromised immune system [7]. Only a proper identification of the local pathogen, as well as information on the susceptibility patterns and any related risk factors, can provide appropriate treatment for UTIs [6]. Because of incorrect antibiotic use, the

bacterial sensitivity pattern of common pathogens is gradually changing in all countries [8]. To decrease the morbidity rate of UTIs, proper treatment is required. The non-specific signs and symptoms of UTIs in children under the age of two years can make it difficult to diagnose UTIs [9]. Children with simple UTIs may respond to sulphonamides, amoxicillin, trimethoprim-sulfamethoxazole, or cephalosporins, with amoxicillin, sulphonamides, trimethoprim-sulfamethoxazole, or cephalosporins concentrating in the lower urinary tract [10]. In high-income countries suggest that bacteria that cause UTIs are more likely to form resistance to conventional antibiotics such as trimethoprim-sulfamethoxazole [11]. The fatality rate of *S. aureus* has been minimized with the help of antibiotics but *S. aureus* quickly develops resistance to antibiotics. Factors like toxins, adhering proteins, enzymes, antimicrobial peptides, and super-antigen make it a major pathogen for humans and animals [12]. Multidrug-resistant *Escherichia coli* has been a topic of concern in the current era because of its wide host range, elevation in its pathogenicity level, competency in survival, and many reported pandemics [13]. Multidrug resistance (MDR) in *E. coli* is a serious issue that poses a risk to human and animal health [14].

This study aims to collect and identify the isolates recovered from the clinical specimens from pediatric patients and the antimicrobial resistance of bacterial isolates as per CLIC guideline 2020.

## Materials and Methodology

### Ethical consideration

Before starting the study, ethical permission was obtained from the Ethical Review Committee, Government College University Faisalabad.

### Consent forms

A consent form was designed that included name, gender, date and time of sampling, and permission from the patients/guardians to use their samples for research purposes. Consent forms were filled out by the patients/guardians at the time of the sampling. The data of the patients were kept secret and not shared with anyone.

### Sample collection

A total of 200 catheter tips were collected from the pediatric patients of different wards (urology, surgery, medicine) at the Children's Hospital Faisalabad. The clinical samples of catheter tips were collected by using sterile scissors and cutting catheter tips from the balloon side by 2cm and transferred into a sterile container.

### Sample processing and staining

Samples were first kept in pre-prepared nutrient broth for 24 hours. The Broth was subcultured on Blood, nutrient, and MacConkey agar plates, and then incubation was done at 37 °C overnight. Bacterial isolate colonies were preliminarily identified based on colony morphology, the color pigment of the isolates, size, and shape of the colonies.

## Gram staining

The basic principle of gram staining is to distinguish between gram-positive and gram-negative bacteria based on a cell wall. Gram staining of the isolates included smear preparation, Gram staining, and microscopy of the colonies. The gram staining observed at 100x, under the microscope; Gram-positive isolates appear to be purple-blue while Gram-negative isolates appear to be pink.

## Biochemical profiling of isolates

Isolates were processed further for biochemical profiling for confirmation of biochemical characteristics. Oxidase, triple sugar iron, citrate, urease, indole, methyl red, and Voges Proskauer tests were conducted and results were noted for each of the processed isolates.

## Antibiotic susceptibility testing

Hudzicki & Kirby-Bauer, 2016 method, measured the sensitivity of bacteria. Results were recorded while different zones appeared on antibiotic agar plates.

## Statistical analysis

Data were analyzed by SPSS software; sheets were prepared for each of the tested samples. Statistical interpretations were performed for analysis of the results.

## Results

A total of 200 samples were processed in this study and 76 (38%) of the samples showed growth on nutrient agar. Sample positivity has been presented in Tables 1,2 presents sample positivity for the tested samples.

### Prevalence of bacteria in samples

76 samples marked positive were processed further for estimation of the prevalence of bacteria. In processed samples high prevalence was marked for *P. aeruginosa* (24/200; 12%) followed by *E. coli* (22/200; 11%) and *S. aureus* (19/200; 9.5%) while 11 *K. pneumoniae* isolates (5.5%) were identified in this study. The results for the prevalence of bacteria have been presented in Table 3.

Table 1: Demographic distribution of total patients

Demographic characteristic	Category	Number (n)	Percentage (%)
Gender	Male	120	60%
	Female	80	40%
	Male to female ratio	3:2	
Sample distribution	Medical ward	68	34%
	Surgical ward	66	33%
	Urology ward	66	33%

Table 2: Positive and negative sample distribution.

	Frequency (n)	Percentage %
Total samples	200	-
Positive samples	76	38%
Negative samples	124	62%

### Patients' clinical demographic distribution for *P. aeruginosa*

In the study of demographic factors for *P. aeruginosa*, in overall sample distribution for investigation of gender, the high prevalence was found for males (15%), for investigation of sample location, the high prevalence was found for surgical wards and urological wards (12.12%) and for investigation of age group, the high prevalence was found for age group 1-4 (13.54%). The results for patients' clinical demographic distribution for *P. aeruginosa* have been presented in Table 4.

### Patients' clinical demographic distribution for *E. coli*

In the study of demographic factors for *E. coli*, in overall sample distribution for investigation of gender, the high prevalence was found for males (13.33%), for investigation of sample location, the high prevalence was found for urological wards (18.18%) and for investigation of age group, the high prevalence was found for age group 5-9 (10.94%). The results for patients' clinical demographic distribution for *E. coli* have been presented in Table 5.

### Patients' clinical demographic distribution for *K. pneumoniae*

In the study of demographic factors for *K. pneumoniae*, in overall sample distribution for investigation of gender, the high prevalence was found for males (7.5%), for investigation of sample location, the high prevalence was found for surgical wards (6.06%) and for investigation of age group, the high prevalence was found for age group 1-4 (7.30%). The results for patients' clinical demographic distribution for *K. pneumoniae* have been presented in Table 6.

### Patients' clinical demographic distribution for *S. aureus*

In the study of demographic factors for *S. aureus*, in overall sample distribution for investigation of gender, the high prevalence was found for males (11.67%), for investigation of sample location, the high prevalence was found for surgical wards (10.61%) and for investigation of age group, the high prevalence was found for age group 1-4 (14.58%). The results for patients' clinical demographic distribution for *S. aureus* have been presented in Table 7.

### Confirmation of the isolates

For confirmation of the isolates, identification of *P. aeruginosa* was carried out on cetrinide agar and smooth, convex colonies with greenish pigment and grape-like odor are the characteristic features of the *P. aeruginosa* isolates. For confirmation of the isolates, identification of *E. coli* was carried out on MacConkey agar and red-pinkish non-mucoid colonies are characteristic features for *E. coli* isolates. For the confirmation of the isolates, identification of *S. aureus* was carried out on blood agar and convex, shiny white hemolytic colonies are characteristic features for *S. aureus* isolates. For the confirmation of the isolates, identification of *K. pneumoniae* was carried out on EMB agar and mucoid pinkish growth is a characteristic feature of *K. pneumoniae* isolates. Growth

**Table 3:** Prevalence of bacteria in samples.

Bacterial specie	Frequency (n)	Prevalence
<i>P. aeruginosa</i>	24	12%
<i>E. coli</i>	22	11%
<i>S. aureus</i>	19	9.5%
<i>K. pneumonia</i>	11	5.5%

**Table 4:** Patients clinical demographic distribution for *P. aeruginosa*.

Demographic factor	Category	No. of samples	Frequency of <i>P. aeruginosa</i>	Prevalence
Gender	Male	120	18	15%
	Female	80	06	7.50%
Sample location	Medical Ward	68	08	11.76%
	Surgical Ward	66	08	12.12%
	Urology Ward	66	08	12.12%
Age group (years)	01-04	96	13	13.54%
	05-08	64	06	9.38%
	09-12	40	05	12.5%

**Table 5:** Patients' clinical demographic distribution for *E. coli*

Demographic factor	Category	No. of samples	Frequency of <i>E. coli</i>	Prevalence
Gender	Male	120	16	13.33%
	Female	80	06	7.50%
Sample location	Medical Ward	68	03	4.41%
	Surgical Ward	66	07	10.29%
	Urology Ward	66	12	18.18%
Age group (years)	01-04	96	11	11.46%
	05-08	64	07	10.94%
	09-12	40	04	10%

**Table 6:** Patients' clinical demographic distribution for *K. pneumoniae*.

Demographic factor	Category	No. of samples	Frequency of <i>K. pneumoniae</i>	Prevalence
Gender	Male	120	09	7.50%
	Female	80	02	2.50%
Sample location	Medical ward	68	04	5.88%
	Surgical ward	66	04	6.06%
	Urology ward	66	03	4.55%
Age group (years)	01-04	96	07	7.30%
	05-08	64	02	3.13%
	09-12	40	02	5%

**Table 7:** Patients' clinical demographic distribution for *S. aureus*.

Demographic factor	Category	No. of samples	Frequency of <i>S. aureus</i>	Prevalence
Gender	Male	120	14	0.1167
	Female	80	05	0.0625
Sample location	Medical ward	68	06	0.0882
	Surgical ward	66	07	10.61%
	Urology ward	66	06	9.09%
Age group (years)	01-04	96	14	14.58%
	05-08	64	03	4.69%
	09-12	40	02	5%

exhibiting the culture characteristics of *P. aeruginosa*, *E. coli*, *K. pneumoniae*, and *S. aureus* has been presented in Figure 1. The isolates were observed under microscope 100 X has been presented in Figure 2.

### Biochemical profiling of isolates

Biochemical profiling of the isolates was carried out for the confirmation of the biochemical characteristics of the isolates. The results of the biochemical profiling of the isolates have been presented in Tables 8,9

### Antibiotic susceptibility testing

Antibiotic susceptibility testing was carried out against the enlisted antibiotics and results were formulated according to the CLSI 2021 guidelines. The results of antibiotic susceptibility profiling of the isolates have been presented in Tables 10–13.

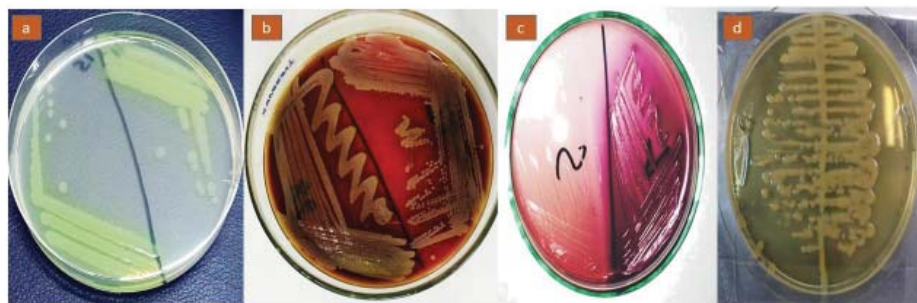
### MDR and MRSA isolate estimation

For Gram-negative bacteria occurrence of MDR isolates was formulated on the basis of resistance in studied isolates while phenotypic detection of MRSA isolates was estimated by cefoxitin disk analysis see Table 14, Figure 3.

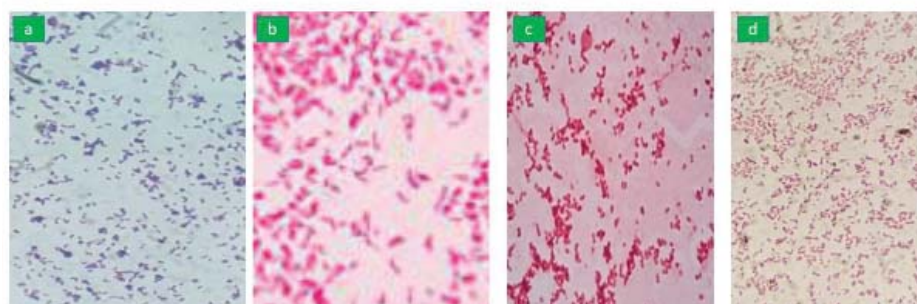
## Discussion

The most frequent bacterial infection in children is urinary tract infection (UTI), which affects 8% of girls and 2% of boys under the age of 7. Also, 30% of people have a chance of developing a second UTI who have already developed a UTI in childhood [15]. Some diseases, such as congenital anomalies of the urinary tract, put some children at a high risk of having UTIs [16]. The upper urinary tract (pyelonephritis or kidney infection) or the lower urinary tract (cystitis or bladder infection) may be affected by UTI and it is very difficult, to differentiate cystitis-based clinical symptoms and indications of pyelonephritis, particularly in children and infants [17]. *Proteus mirabilis* is more frequent in males than in girls while in newborn infants *Streptococcus agalactiae* is more common than *Haemophilus influenza*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus viridians*, *Streptococcus pneumoniae*, and *Streptococcus agalactiae* may be responsible in children with anomalies of the urinary tract (anatomic, neurologic, or functional) or compromised immune system [17].

Only a proper identification of the local pathogen, as well as information on the susceptibility pattern and any related risk factors, can provide appropriate treatment for UTIs. Because



**Figure 1:** Confirmation of isolates (a) Smooth, convex colonies with greenish pigment exhibiting growth of *P.aeruginosa* on cetrimide agar (b) convex shiny white hemolytic exhibiting growth of *S.aureus* on blood agar (c) red-pinkish non-mucoid colonies presenting the growth of *E.coli* on MacConkey agar (d) Mucoid growth presenting culture of *K. pneumoniae*.



**Figure 2:** Presenting microscopy of (a) *S.aureus* (b) *E.coli* (c) *K.pneumoniae* (d) *P.aeruginosa* observed at 100x.

**Table 8:** Biochemical profiling for Gram-negative isolates.

Bacteria	Oxidase	TSI	Indole	Citrate	Urease	Methyl red	Voges Proskauer
<i>E. coli</i>	Negative	Positive	Positive	Negative	Negative	Positive	Negative
<i>P. aeruginosa</i>	Positive	Negative	Negative	Positive	Negative	Negative	Negative
<i>K. pneumoniae</i>	Negative	Positive	Negative	Positive	Positive	Negative	Positive



of incorrect antibiotic use, the bacterial sensitivity pattern of common pathogens is gradually changing in all countries [18]. To decrease the morbidity rate of UTIs, proper treatment is required [19]. Keeping in view the above facts and figures and the importance of UTIs in pediatrics, the current study was designed with the objectives to isolate and identify catheter-associated bacterial pathogens in UTIs among pediatric patients and to estimate the prevalence and antibiotic susceptibility

**Table 9:** Biochemical profiling for *S. aureus* isolates.

Catalase	Coagulase
Positive	Positive

**Table 10:** Presenting antibiotic susceptibility profiling of *P. aeruginosa* isolates.

Antibiotic	Susceptible	Intermediate	Resistant
Gentamicin	13 (54.17%)	02 (8.33%)	09 (37.50%)
Ciprofloxacin	12 (50%)	01 (4.17%)	11 (45.83%)
Meropenem	09 (37.50%)	03 (12.50%)	12 (50%)
Imipenem	17 (70.83%)	02(8.33%)	05 (20.83%)
Tobramycin	10 (41.67%)	01(4.17%)	13 (54.17%)
Ceftazidime	11 (45.83%)	01(4.17%)	12 (50%)
Cefotaxime	10 (41.67%)	02(8.33%)	12 (50%)
Amikacin	12 (50%)	01(4.17%)	11 (45.83%)
Colistin	24 (100%)	0	0
Ampicillin	0	0	100

**Table 11:** Presenting antibiotic susceptibility profiling of *K. pneumoniae* isolates.

Antibiotic	Susceptible	Intermediate	Resistant
Gentamicin	05 (45.45%)	01 (9.09%)	05 (45.45%)
Ciprofloxacin	05 (45.45%)	02 (18.18%)	04 (36.36%)
Meropenem	04 (36.36%)	01 (9.09%)	06 (54.54%)
Imipenem	08 (72.73%)	0	03 (27.27%)
Tobramycin	04 (36.36%)	01 (9.09%)	06 (54.54%)
Ceftazidime	04 (36.36%)	01 (9.09%)	06 (54.54%)
Cefotaxime	03 (27.27%)	01 (9.09%)	07 (63.63%)
Amikacin	04 (36.36%)	01 (9.09%)	06 (54.54%)
Colistin	11 (100%)	0	0
Ampicillin	0	0	100

**Table 12:** Presenting antibiotic susceptibility profiling of *E. coli* isolates.

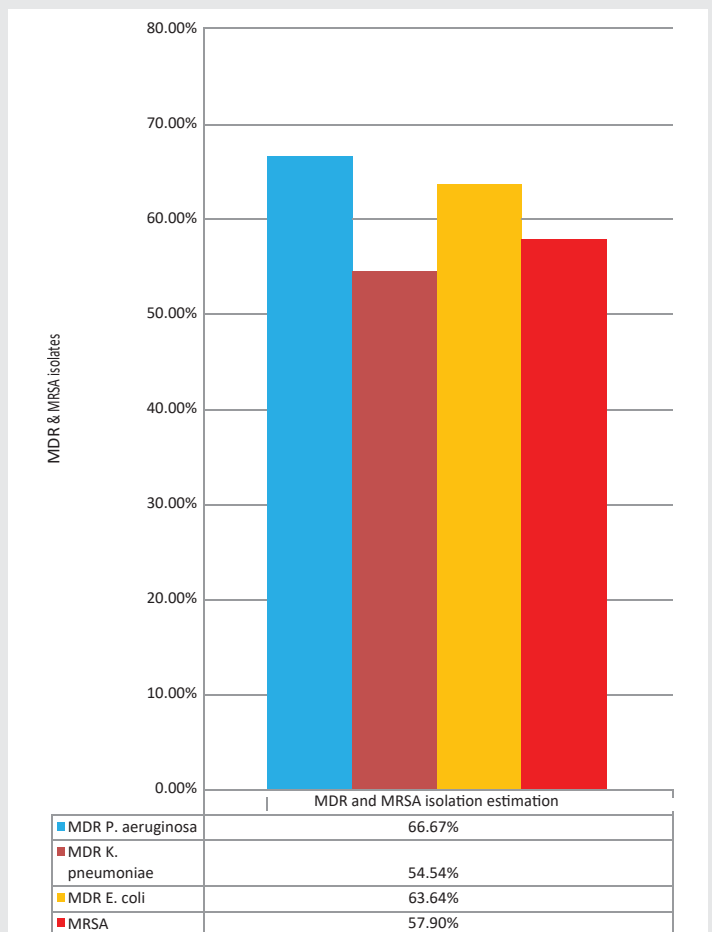
Antibiotic	Susceptible	Intermediate	Resistant
Gentamicin	09 (40.91%)	01 (4.55%)	12 (54.55%)
Ciprofloxacin	12 (54.55%)	02 (9.10%)	08 (36.36%)
Meropenem	09 (40.91%)	02 (9.10%)	11 (50%)
Imipenem	14 (63.64%)	01 (4.55%)	07 (31.82%)
Tobramycin	09 (40.91%)	02 (9.10%)	11 (50%)
Ceftazidime	08 (36.36%)	03 (13.64%)	11 (50%)
Cefotaxime	10 (45.45%)	02 (9.10%)	10 (45.45%)
Amikacin	10 (45.45%)	01 (4.55%)	11 (50%)
Colistin	22 (100%)	0	0
Ampicillin	0	0	100

**Table 13:** Presenting antibiotic susceptibility profiling of *S. aureus* isolates.

Antibiotic	Susceptible	Intermediate	Resistant
Penicillin	08 (42.11%)	03 (15.79%)	08 (42.11%)
Cefoxitin	11 (57.89%)	01 (5.26%)	07 (36.84%)
Erythromycin	08 (42.11%)	02 (10.53%)	09 (47.37%)
Ampicillin	09 (47.37%)	01 (5.26%)	09 (47.37%)
Trimethoprim-sulfamethoxazole	11 (57.89%)	02 (10.53%)	06 (31.58%)
Tetracycline	09 (47.37%)	02 (10.53%)	08 (42.11%)
Azithromycin	08 (42.11%)	03 (15.79%)	08 (42.11%)
Clindamycin	11 (57.89%)	01 (5.26%)	07 (36.84%)
Ciprofloxacin	10 (52.63%)	03 (15.79%)	06 (31.58%)
Vancomycin	19 (100%)	0	0

**Table 14:** MDR isolates detection for studied bacteria.

Bacteria	No. of isolates	Frequency of MDR isolates	Percentage of MDR isolates
<i>P. aeruginosa</i>	24	16	66.67%
<i>K. pneumoniae</i>	11	6	54.54%
<i>E. coli</i>	22	14	63.64%
<b><i>S. aureus</i></b>			
MRSA	No. of isolates	Frequency of MRSA	Percentage of MDR isolates
	19	11	57.90%



**Figure 3:** Graph presenting MDR isolates detection for studied bacteria.

profiling of catheter-associated bacterial pathogens in UTIs among pediatric patients.

A total of 200 catheter tips were collected from the patients of different wards (surgery, urology, medicine) at the Children's Hospital Faisalabad. Samples were first kept in pre-prepared nutrient broth for 24 hours and then streaked on nutrient agar plates and the positivity of the samples was noted after 24 hours. Positive samples were processed further for the identification of *E. coli*, *K. pneumoniae*, *S. aureus*, and *P. aeruginosa* using culture identification, microscopy, and biochemical profiling on the basis of culture characterization, microscopy, and biochemical profiling. Cultures were processed on selective agar, set for incubation at 37 °C for 24 hours, and processed further for Gram-staining, microscopy, and biochemical profiling using oxidase, catalase, triple sugar iron, urease, indole, methyl red, and Voges Proskauer test. Antibiotic susceptibility testing was performed to determine the antibiotic resistance profile of each isolate by disc diffusion method. Antibiotics were selected based on clinical relevance which belongs to different antimicrobial groups. The zone of inhibition was interpreted according to Clinical and Laboratory Standards Institute guidelines (CLSI) 2021 and isolates were determined as resistant, intermediate, and susceptible according to CLSI guideline 2021.

A total of 200 samples were processed in this study and 76 (38%) of the samples showed growth on nutrient agar. In processed samples, the high prevalence was marked for *P. aeruginosa* (24/200; 12%) followed by *E. coli* (22/200; 11%) and *S. aureus* (19/200; 9.5%) while 11 *K. pneumoniae* isolates (5.5%) were identified in this study. This study showed relevance with the results presented by Mishra & Wadhwa (2016) in research designed on *P. aeruginosa* in OT samples [20], Mohammad, et al. 2017 in research designed on *K. pneumoniae* in OT samples, Dhom, et al. (2017) in a method of research on *E. coli* in surgical sites [21]. These results were also supported by the results presented by Sapkota, et al. (2016) in the method of research on *P. aeruginosa* in ward samples [22], Baban, et al. (2019) in research designed on *E. coli* on surgical ward samples [23], and Yusuf, et al. (2017) in a study designed on OT samples. In a comparative study designed on clinical isolates, Habyarimana, et al. (2020) reported the prevalence of *P. aeruginosa* at 22.50%, *E. coli* at 7.5%, and *K. pneumoniae* isolates at 15% [24].

In antibiotic susceptibility profiling of *P. aeruginosa*, the highest susceptibility was found for colistin (100%) and imipenem (70.83%) followed by gentamicin (54.17%) while the highest resistance was found for tobramycin (54.17%) followed by meropenem, ceftazidime, and cefotaxime (50%). In a comparative study designed on catheter samples in the Czech Republic Olejnickova, et al. (2014) also reported more than 90% susceptibility to colistin however resistance to ciprofloxacin (56.6%) and gentamicin (42.9%) and a little susceptibility to amikacin (lesser than 10%) was reported in *P. aeruginosa* isolates [25]. Bizuayehu, et al. (2022) in Ethiopia also designed a comparative study on catheter samples and also reported imipenem as a susceptible antibiotic (85.3%) reported high resistance to ceftazidime (83.3%) and resistance to gentamicin (41.7%) and tobramycin (41.7%) were also

reported in *P. aeruginosa* isolates [26]. The minor difference in results might be due to the difference in the demographic location of the study.

In antibiotic susceptibility profiling of *K. pneumoniae* highest susceptibility was found for colistin (100%) and imipenem (72.73%) followed by gentamicin and ciprofloxacin (45.45%) while the highest resistance was found for cefotaxime (63.63%) followed by meropenem, tobramycin and amikacin (54.54%). Hyun, et al. (2019) designed a study on clinical samples in Korea and reported high susceptibility to amikacin (94.4%), gentamicin (80.3%), ciprofloxacin (70.4%), and cefotaxime (53.5%) were reported [27]. The difference in results might be due to differences in sample type and location of the sampling.

In antibiotic susceptibility profiling of *E. coli*, the highest susceptibility was found for colistin (100%) and imipenem (63.64%) followed by ciprofloxacin (54.55%) while the highest resistance was found for gentamicin (54.55%) followed by tobramycin, meropenem, ceftazidime, and amikacin (50%). In a comparative study designed on clinical samples in Korea, Hyun, et al. (2019) reported 99.2% susceptibility to amikacin, 56% to ciprofloxacin, and 66.1% to gentamicin. These results were also supported by El-Mahdy, et al. (2021) in a study designed on catheter samples in Ethiopia in which 55.6% resistance to ceftazidime was reported [28]. Almost similar results were also reported by Vidyasagar & Nagarathnamma, (2018) in a study designed on *E. coli* isolates from catheter samples also reported high susceptibility to imipenem (95.7%), amikacin (58.7%), and tobramycin (58.7%) [29]. Bizuayehu, et al. (2022) in a study designed on catheter samples in Nepal in which 100% susceptibility to imipenem and 37.5% resistance to ceftazidime was reported however 100% susceptibility to meropenem and amikacin was also reported in *E. coli* isolates [30]. Ndomba, et al. (2022) in a study designed on catheter samples in Tanzania also reported 50.7% resistance to ceftazidime in *E. coli* isolates however a bit of fluctuation in resistance to gentamicin (43%) was also reported [31].

In antibiotic susceptibility profiling of *S. aureus* highest susceptibility was found for vancomycin (100%) clindamycin, cefoxitin, and trimethoprim-sulfamethoxazole (57.89%) while the highest resistance was found for erythromycin and ampicillin (47.37%). Vidyasagar & Nagarathnamma, (2018) in a study designed on *S. aureus* in catheter samples also reported 100% resistance to vancomycin however a little susceptibility to erythromycin (20%) and clindamycin (20%) was found in these isolates.

A high prevalence of pathogens in catheter samples has been alarming and has been worsened with the presence of resistant isolates that have not only been found resistant to antibiotics studied. Advance studies are needed to investigate the real investigations of bacterial contamination; resistance to treatment options and resistance to antibiotics are needed.

## Conclusion

This study concluded that the high prevalence was determined for *P. aeruginosa* (24/200; 12%) and *E. coli* (22/200; 11%). In this study, the male patients were mostly infected as



compared to females (3:2). The antimicrobial profile suggested that 54.17 % of *P. aeruginosa* were resistant to tobramycin, and the highly sensitive drug was colistin (100%). In antibiotic susceptibility profiling of *K. pneumoniae*, the highest susceptibility was found for colistin (100%) and the highest resistance was found for cefotaxime (63.63%).

In antibiotic susceptibility profiling of *E. coli*, the highest susceptibility was found for colistin (100%) while the highest resistance was found for gentamicin (54.55%). In antibiotic susceptibility profiling of *S. aureus* highest susceptibility was found for vancomycin (100%) while the highest resistance was found for erythromycin and ampicillin (47.37%). There should be public awareness of the use of antibiotics, there should be a stoppage of irrational use of antibiotics, people should not take self-antibiotics, over-the-counter availability of antibiotics should be banned, and continuous education on health care.

Advanced studies are needed to investigate the real investigations of bacterial contamination resistance to treatment options and resistance to antibiotics is needed.

## Declaration

**Availability of data and materials:** Availability of data and materials on request by the corresponding author

**Authors' contributions:** All authors contribute equally

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