Original Article

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Bacteriological Profile of Urinary Tract Infections and their Antibiotic Susceptibility Patterns in a Tertiary Care Hospital

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Abstract

Background: Changing trend in the causative agents of urinary tract infection (UTI) and their antibiogram requires area specific sensitivity data for formulation of empirical therapy guidelines.

Aim: To determine the etiological agents of UTI and their susceptibility patterns.

Setting and Study Design: Cross sectional study was carried out in the department of Microbiology of a tertiary care teaching hospital.

Materials and Methods: A total of 500 midstream clean catch urine specimens were subjected to culture and the isolates were identified by standard methods. Antibiotic susceptibility testing was carried out by Kirby-Bauer Disc diffusion method. Staphylococcal isolates were tested for methicillin resistance and Gram negative bacilli (GNB) for extended spectrum beta lactamase production (ESBL) as per CLSI guidelines.

Statistical analysis: The results were expressed in percentages and proportions.

Results: Significant growth was noted in 44.2% of cases. *E.coli* was the most common isolate (41.2%) followed by *Enterococcus* species (19%). Majority of GNB were susceptible to *Amikacin* (73.6%). All Gram positive cocci (GPC) were sensitive to *Vancomycin. Linezolid* and *Nitrofurantoin* sensitivity was seen in 98.2% and 80.4% of *GPC* respectively. *Methicillin* resistant Co-agulase negative Staphylococci constituted 63.6% of *Staphylococcal* isolates. ESBL was detected in 7.4% of GNB.

Conclusion: E.coli was the most common isolate. *Amikacin* can be considered for empirical treatment of *GNB* and *Nitrofurantoin* for *GPC*. *Imipenem, Vancomycin* and *Linezolid* should be used only after obtaining culture and sensitivity report. Higher methicillin resistance observed among Coagulase negative *Staphylococci* is an alarming sign.

Keywords: Antibiotic resistance; *Amikacin; E.coli; Nitrofurantoin*; Uropathogens.

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Introduction

Urinary tract infections (UTIs) are the second most common infections with around 150 million cases occurring per annum worldwide.[1] UTI may range from asymptomatic bacteriuria to urosepsis and even death.[2] It remains a major public health problem in terms of financial burden and morbidity. In almost all cases of UTI, the antimicrobial therapy is initiated empirically

till laboratory reports of urine culture are available[3]. Changing patterns in the prevalence of uropathogens as reported by many studies[4,5] and increased isolation of drug resistant uropathogens is posing a problem for empirical treatment.[6,7] Indiscriminate and injudicious antibiotic prescription by health professionals and misuse by patients have led to the development of drug resistance.[8] Further, the development of new resistance mechanisms and spread of resistance genes among bacteria are also contributing to antibacterial resistance among uropathogens.[1,9] If proper empirical antibiotic is not selected, it may lead to treatment failure and result in increased mortality due to urosepsis.[7]

This will also add on to further emergence of drug resistance due to inappropriate antibiotic use. For selection of appropriate empirical antimicrobial agent, the data regarding the likely pathogens causing UTI and their susceptibility and resistance patterns in the given locality is very much essential.[3,10] With this background, the present study was undertaken to determine the etiological agents of UTI and their antibiotic susceptibility pattern.

Materials and Methods

The present cross sectional study was carried out in the Department of Microbiology of Adichunchanagiri Institute of Medical Sciences, B.G. Nagara over duration of 8 months after getting ethical clearance from the Institution and informed consent from the study participants.

Inclusion criteria

Five hundred midstream clean catch urine specimen collected from patients of more than 5 years of age with symptoms of UTI, attending various outpatient departments and admitted in the wards of Adichunchanagiri Hospital and Research Centre and were submitted to microbiology laboratory were randomly selected for the study.

Exclusion criteria:

Repeat isolates from the patient, patients on antibiotic therapy and patients with history of antibiotic intake within one week prior to specimen collection were excluded from the study.

Midstream clean catch urine specimens were processed without delay in the laboratory and were subjected to culture by standard loop method on 5% sheep blood agar and MacConkey agar plates (Hi Media Mumbai India). The inoculated plates were incubated aerobically at 37°C for 24–48 hours. The isolates with significant count (≥ 10^5 colony forming units/ ml of urine) were identified by standard microbiological methods.[11] Antibiotic susceptibility testing was carried out by Kirby-Bauer disc diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines[12] using following antibiotic discs: Ampicillin (10 μg), Amoxicillin-Clavulanic acid (20/10 μg), Ceftriaxone (30 μg), Ceftazidime (30 μg), Cefepime (30 μg), Imipenem (10 μg), Cotrimoxazole (1.25/23.75 μg), Tetracycline (30 μg), Cefoxitin (30 μg), Linezolid (30 μg), Nitrofurantoin (300 μg), Norfloxacin (5 μg), ofloxacin (5 μg), Gentamicin (10 μg), Amikacin (30 μg), Vancomycin (30 μg), and Piperacillin–Tazobactam (100/10 μg). Staphylococcal isolates were tested for methicillin resistance by Cefoxitin disc diffusion method and all Gram negative isolates were tested for Extended Spectrum Beta Lactamase (ESBL) by combination disc method using Ceftazidime (30 μg) disc and Ceftazidime + Clavulanic acid (30 μg + 10 μg) disc as per CLSI guidelines.[12] *E.coli* ATCC 25922, S. aureus ATCC 25923, Ps. aeruginosa ATCC 27853 and E. faecalis ATCC 29212 were used as control strains.[1]

Statistical analysis

Results were expressed in terms of proportion and percentages.

Results

Out of 500 cases included in the study, females constituted 54.2% (271) and males 45.8% (229) of study group.

Figure 1 shows the culture results obtained in the study. Significant growth was observed in 44.2% (221) of cases. Significant growth was observed in 57% (126) of females and 43% (95) of males.

Figure 2 shows the organisms isolated in the study. *E.coli* (41.2%) was the commonest isolate obtained followed by *Enterococcus species* (19%) and *Klebsiella spp* (10.4%). Candida species constituted 3.6% (8) of total isolates and 3(37.5%) were non-albicans Candida species.

Gram negative bacilli (GNB) constituted 69.95% (149) of bacterial culture isolates and *Gram positive cocci* (GPC) constituted 30.05% (64).

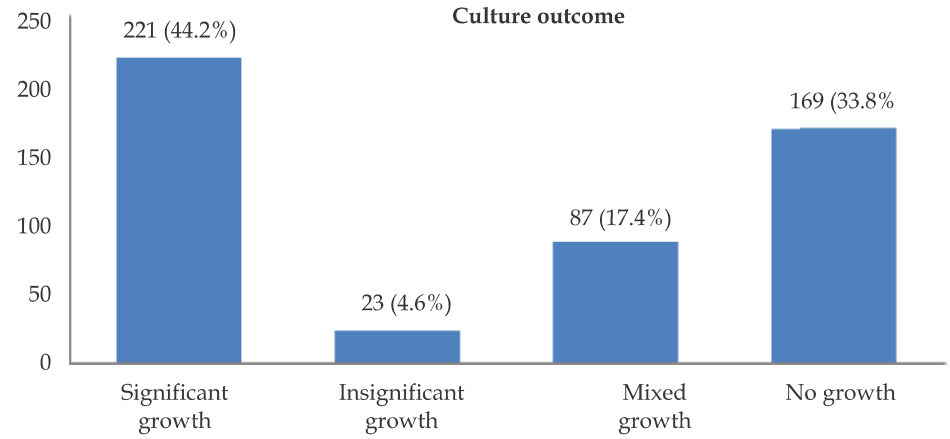

Fig. 1: Culture results obtained in the study

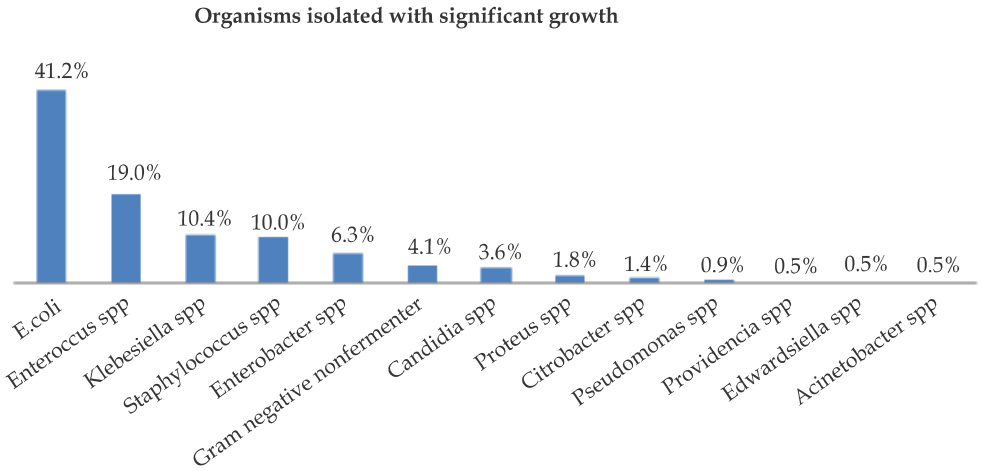

Fig. 2: Organisms isolated with significant growth

Table 1 shows the antibiogram of Gram negative bacterial isolates observed in the study. Majority of *GNB* were susceptible to *Amikacin* (73.6%) followed by *Imipenem* (60%) and *Gentamicin* (58.6%).

Table 1: Antibiogram of Gram negative bacilli observed in the study

Antibiotics	Susceptible (%)	Resistant (%)
Ampicillin	12.1	87.9
Amoxicillin-Clavulanic acid	14.9	85.1
Piperacillin-Tazobactam	35.4	64.6
Ceftriaxone	18.9	81.1
Cefepime	20.2	79.8
Ceftazidime	19.2	80.8
Cotrimoxazole	39.9	60.1
Tetracycline	26.7	73.3
Nitrofurantoin	47.7	52.3
Norfloxacin	36.8	63.2
Ofloxacin	41.2	58.8
Gentamicin	58.6	41.4
Amikacin	73.6	26.4
Imipenem	60	40.0

Table 2 shows the antibiogram of Gram positive bacterial isolates. All GPC were susceptible to *Vancomycin* (100%). Linezolid and Nitrofurantoin sensitivity was observed in 98.2% and 80.4% of GPC respectively.

Table 2: Antibiogram of Gram positive cocci observed in the study

Antibiotics	Resistant (%)	Sensitive %
Ampicillin	63.2	36.8
Amoxilcillin-Clavulanic acid	56.5	43.5
Ceftriaxone	85.7	14.3
Cefepime	71.4	28.6
Ceftazidime	85.7	14.3
Cotrimoxazole	68.4	31.6
Tetracycline	58.5	41.5
Linezolid	1.8	98.2
Nitrofurantoin	19.6	80.4
Norfloxacin	73.3	26.7
Ofloxacin	69.8	30.2
Gentamicin	54.2	45.8
Vancomycin	0.0	100.0

Figure 3 shows the susceptibility pattern of *E. coli* and *Klebsiella* isolates obtained in the study. Majority of *E.coli* isolates were susceptible to *Amikacin* (75.6%) followed by *Imipenem* (68.3%), *Nitrofurantoin* (62.9%) and *Gentamicin* (60.2%). All *Klebsiella* isolates were resistant to Ampicillin and Amoxicillin-Clavulanic acid combination, (100%) each. Majority of *Klebsiella* isolates were susceptible to *Amikacin* (69.6%), followed by Cotrimoxazole (63.6%) and *Gentamicin* (59.1%).

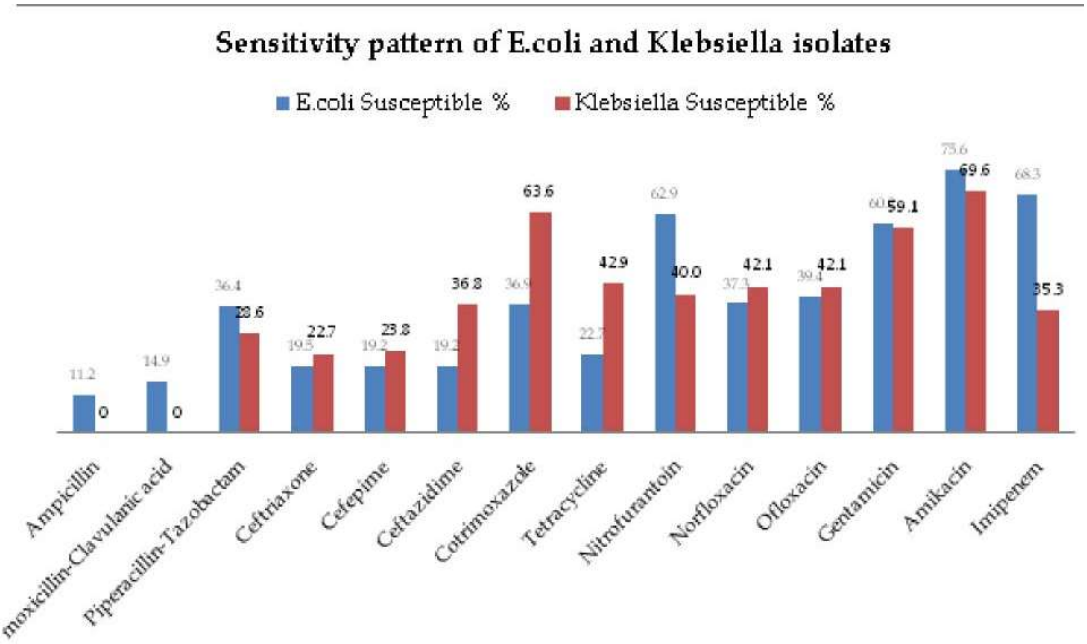

Fig. 3: Susceptibility pattern of E. coli and Klebsiella isolates

Figure 4 shows the resistance pattern of the *Enterococcal* isolates. Around 50% to 60% of isolates were resistant to High level *Gentamicin*, fluoroquinolones and Tetracycline. All Enterococcal isolates were susceptible to *Vancomycin* and *Linezolid* (100%) each.

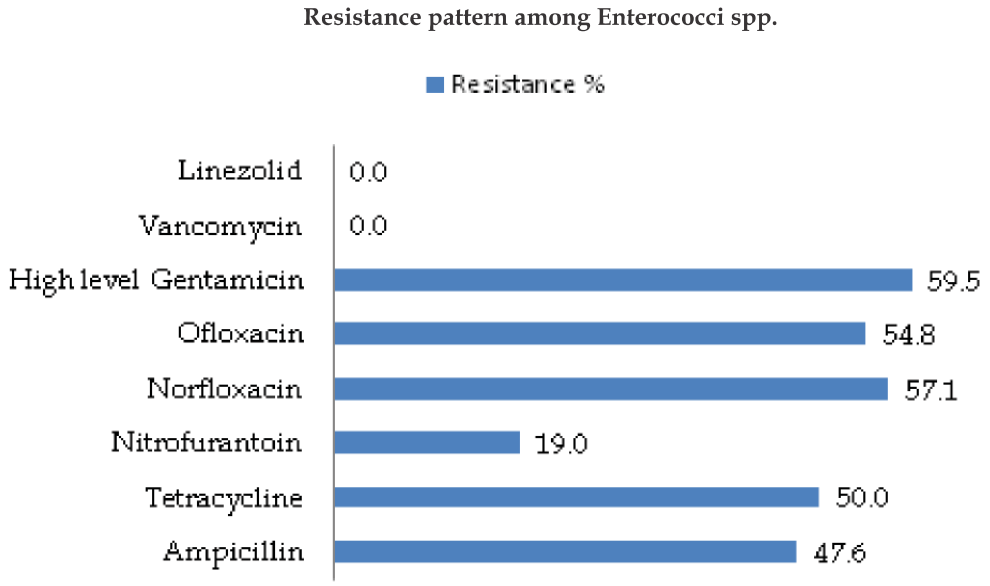

Fig. 4: Resistance pattern of Enterococcal isolates

Figure 5 shows the sensitivity pattern of *Staphylococcal* isolates. All *Staphylococcal* isolates were sensitive to *Vancomycin* and *Amikacin* (100%) each. *Linezolid, Nitrofurantoin* and *Gentamicin* sensitivity was observed among 94.4% each of *staphylococcal* isolates.

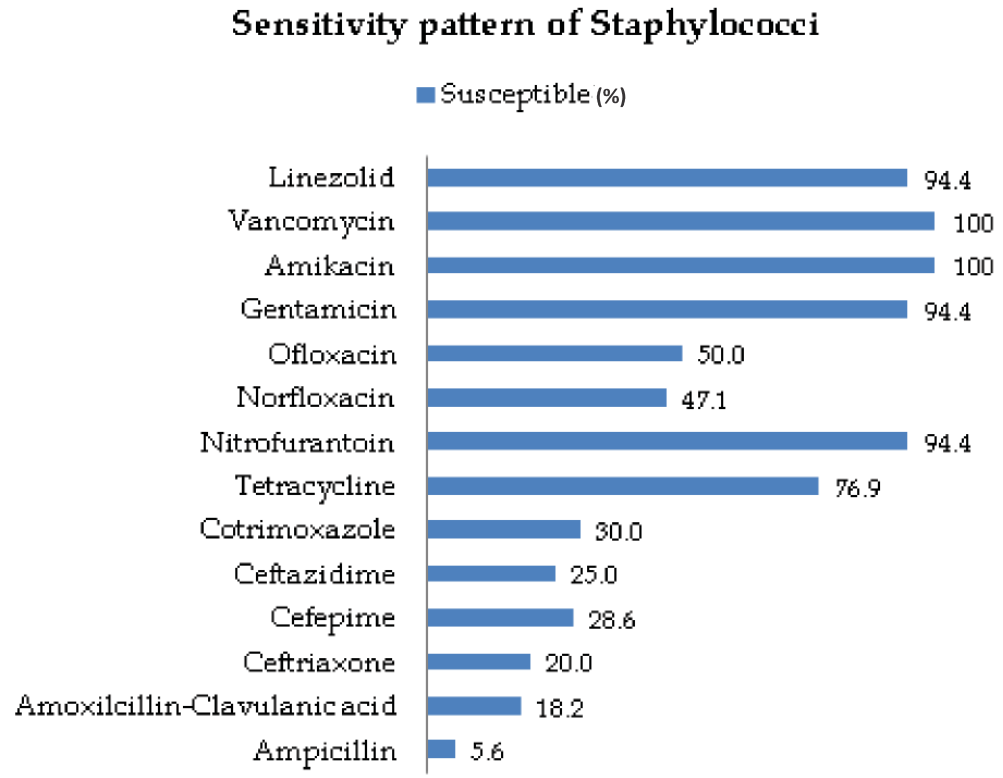

Fig. 5: Susceptibility pattern of *Staphylococcal* isolates

Table 3 shows the *methicillin* resistance pattern observed among Staphylococcal isolates. *Methicillin* resistant Co-agulase negative *Staphylococci* constituted 63.6% of *Staphylococcal* isolates. Out of 149 GNB, 11 (7.4%) of the isolates produced ESBL.

Table 3: Methicillin resistance observed among *Staphylococcal* isolates

Staphylococcal isolates	Number	Percentage
Methicillin Resistant Coagulase negative *Staphylococci* (MRCONS)	14	63.6
Methicillin susceptible Coagulase negative *Staphylococci* (MSCONS)	5	22.7
Methicillin resistant *Staphylococcus aureus* (MRSA)	1	4.5
Methicillin susceptible *Staphylococcus aureus* (MSSA)	2	9.1
Total	22	100.0

Discussion

Higher prevalence of UTI occurs both in the community and nosocomial settings.[4] Timely and effective treatment of accurately diagnosed UTI, can assist in reducing further progressive damage to kidney and in turn renal scarring.[13] The national or international guidelines for empirical therapy of UTI cannot be applied for specific geographical regions as the etiological agents and their antibiotic susceptibility patterns vary in time and at different places.[5] The information regarding the current local trend in any hospital is very essential for effective therapy and for dealing with emerging problems of multidrug resistant uropathogens.[4]

In the present study, significant growth was noted in 44.2% of urine specimens and was observed more among females patients (57%). This is in concordance with study by Ghadage *et al*.[13] Badhan *et al*.[5] have reported lower rates (26.7%). Short urethra and its proximity to anus along with hormonal influences and behavioral patterns contribute to higher incidence of UTI in females.[13,14]

In the present study, GNB constituted 69.95% of isolates and GPC 30.05% of isolates similar to study by Ghadage *et al*.[13] E. coli (41.2%) was the most common bacteria isolated as in other studies.[2,4,5,13] *E.coli* is one of the commensal flora in the gastro intestinal tract and possess virulent factors such as pili, fimbriae, and P1-blood group phenotype receptor which all assist in adhesion of E. coli to uroepithelial cells accounting for common organism to be isolated in various studies.[2] *Enterococcus* species (19%) was the second most common bacteria isolated in the present study, followed by *Klebsiella* species (10.4%). Similar results were stated in studies by Badhan *et al*.[5] and Sanjee *et al*.[2] However, few[4,13,15,16] have reported *Klebsiella* as the second common isolate and few others found *S. aureus*,[14,17] *Pseudomonas aeruginosa*[18] and *Coagulase negative Staphylococci* (CONS)[19] as the second most common isolate in their studies. *Candida* species were isolated in 3.6% of cases similar to study by Yadav *et al*.[14] However, Kumar *et al* found little high Candida species isolation rate of 7.69%.[18]

The variation observed in the etiological agents in different studies may be due to the fact that, the urinary pathogens differ in different geographical regions and depend on study group characteristics like age, gender and also depends on when the study was conducted[4]

In the present study, majority of GNB were susceptible to *Amikacin* (73.6%) followed by *Imipenem* (60%) and *Gentamicin* (8.6%). On contrary, Ghadage *et al*.[13] have reported higher sensitivity rate to *Nitrofurantoin* (85.3%) followed by to *Gentamicin* and *Amikacin*, around 75%.

All of GPC were susceptible to vancomycin (100%) like in other studies[13,14] Linezolid and Nitrofurantoin sensitivity was noted in 98.2% and 80.4% of GPC respectively. Whereas few authors found lower[13] and few higher sensitivity rates.[19]

In the present study, majority of E. coli were sensitive to *Amikacin* (75.6%) followed by *Imipenem* (68.3%), *Nitrofurantoin* (62.9%) and *Gentamicin* (60.2%). Many authors found still higher sensitivity rate.[2,4,14,15] But in one study 37% sensitivity to Meropenem was found.[17] Higher resistance was noted to *Ampicillin, cephalosporins* and *cotrimoxazole* (Figure 3). This is in concordance with other studies.[2,18]

All *Klebsiella* isolates were resistant to *Ampicillin* and Amoxicillin- Clavulanic acid combination (100%) similar to study by Kengne *et al*.[15] *Amikacin*, *Cotrimoxazole* and *Gentamicin* sensitivity was noted in 69.6%, 63.6% and 59.15% of isolates respectively. Few authors had found higher sensitivity rates to aminoglycosides.[15,16] In contradiction to our study, Kilbret *et al*.[16] found the

isolates more resistant to *Cotrimoxazole* (61.1%). In the present study, ESBL was produced by 7.4% of GNB. Higher rates were reported by others.[13,15]

In the present study, all *Enterococcal i*solates were sensitive to *Vancomycin* and *Linezolid* and 81% of isolates were sensitive to *Nitrofurantoin* similar to other study.[14]

All *Staphylococcal* isolates were sensitive to *Vancomycin* and *Amikacin* (100%). Sensitivity to *Linezolid, Nitrofurantoin* and *Gentamicin* was observed among 94.4% each of Staphylococcal isolates like in other studies.[14,16] *Methicillin* resistance was observed more among CONS (63.6%). On contrary in other study, lower *methicillin* resistance was found and was found more among S. aureus isolates than among CONS.[14]

Few differences noted in the antibiotic susceptibility patterns across various studies may be due to differences in the antibiotic prescription practices and also due to injudicious and indiscriminate use of antibiotics in different regions. The higher sensitivity noted to aminoglycosides may be attributed to injectable nature of the drugs and hence are not used commonly in the community set up, hence less selection pressure to the drug. Higher resistance observed to penicillin group of drugs, cephalosporins and fluoroquinolones may be due to extensive prescription of these drugs both in the community and hospital settings and due to misuse and self medication by patients.[14]

Limitation of the study include, inadequate sample size hence the findings cannot be generalized. In ability to get clinical correlation (type of UTIs) and not differentiating community acquired and nosocomial UTIs are the other limitations.

Conclusion

To conclude, as etiology of UTI and susceptibility pattern vary in regions and change through time, emphasis should be given to continuous surveillance to find out the current regional trend of uropathogens and the data can be used to formulate effective empirical therapy guidelines. *E.coli* was the commonest pathogen isolated followed by *Enterococcus* species. *Amikacin* can be added to empirical treatment of *GNBs* and *Nitrofurantoin* for GPC. Higher *methicillin* resistance noted in the study is an alarming sign. Resistance observed to reserve drugs like *Carbapenem* and *Linezolid* is a significant finding and these drugs need to be prescribed only after culture and sensitivity report.

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Conflict of interests: Nil

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