Original Article

Bacteriologic Profile and Antibiotic Susceptibility in Patients with UTIs in Tertiary Care Hospital

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ABSTRACT

OBJECTIVES: To evaluate the bacteriological profile and antibiotic susceptibility in patients with urinary tract infections.

METHODOLOGY: This retrospective study with a cross-sectional design was held at Dow University of Health Sciences, Karachi; we evaluated records of patients from January to December 2020 at the Department of Microbiology, Dow Diagnostic Reference and Research Laboratory, Karachi, who requested urine culture due to urinary tract infection. Details such as the most common bacteria, specific antibiotic susceptibility and resistance with all demographic information were recorded.

RESULTS: A total of 57785 samples were collected, of which 19620 were positive. The highest bacterial contaminations of the urinary region were detected among Females. *E.coli* remains a dominant pathogen that affects all age groups and genders, followed by *Klebsiella, Acinetobacter, Enterobacter* and *Proteus*. The most resistant drugs observed in our study were cefixime and cefuroxime, followed by ampicillin and Cotrimoxazole. The most sensitive and minor resistant drug against isolates is Colistin, followed by Amikacin and nitrofurantoin.

CONCLUSION: It is among the studies with significant findings and delivers essential data regarding bacterial trends. Current research can be compared with other studies for antimicrobial susceptibility approaches of pathogens and helps us decide on empirical treatment of UTIs. Parallel analysis should be designed on a large scale in diverse areas and regions, forming empiric antibiotic therapy guidelines according to the local antimicrobial susceptibility pattern, which helps improve patient outcomes and unjudicial antibiotic use.

KEYWORDS: Urinary infections, Uro-pathogens, antibiotic resistance and sensitivity

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INTRODUCTION

Infections of the genitourinary tract (urethra, bladder and kidneys) are caused by microorganisms from skin or rectum ascending through the urethra and can affect any part of the urinary tract[1]. It is labelled based on the location of the infection, urethritis when it is present in the urethra, cystitis in the urinary bladder and pyelonephritis in the kidneys. UTIs can be categorized as uncomplicated or complicated cases. Uncomplicated UTIs are most common and occur in generally healthy individuals with no physical or neurologic anomalies in the genitourinary system. Primarily seen in women in the outpatient setting and occasionally in some subsets of the male population like uncircumcised infants and elderly males[2-4]. Conversely, complicated UTIs are related to patient-level features that affect urodynamics or compromise host immune mechanisms, such as urinary catheterization, urinary obstruction or retention, immunosuppression, renal failure, renal transplantation, and pregnancy. One of the most common causes of UTI that shows complications are catheterization of the urinary tract, which can commonly lead to bloodstream infections[5].

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More than 150 million individuals are infected yearly, making UTIs a global health concern[6]. UTIs account for approximately 40% of all hospital-acquired infections. The main culprits that cause urinary tract infections are bacteria, fungi and parasites. Uropathogenic *Escherichia coli* is one of the leading causes of uncomplicated and complicated UTIs. UPEC still has a high prevalence in uncomplicated UTIs, followed by *Klebsiella pneumonia*, *Staphylococcus saprophyticus*, *Enterococcus faecalis*, group[4], Group B *Streptococcus*(GBS), *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Candida* spp[7]. In lieu of complicated UTIs, the order of prevalence for causative agents, following UPEC as most common, is *Enterococcus*spp, *K. pneumonia*, *Candida*spp *S. aureus P. mirabilis P. aeruginosa* and GBS[8].

UTIs are more often than not treated with antibiotics or are self-resolving. However, UTIs commonly reoccur due to their ability to reproduce, invade host cells, and develop antibiotic resistance. Still, the antibiotic used for UTI treatment can also cause resistance, which is a big hurdle in future management plans.

Urine cultures are an efficient way to receive an educated analysis of that specific microorganism. Results of urine culture and antibiotic susceptibility reports can help modify treatments specific to the causative organism and thus provide better outcomes[9] and can help a particular population in creating detailed treatment plans without any delay[10]. Several establishments have provided profiles of bacteria and antibiotic susceptibility; however, they can vary from one area to another and have different yearly trends[10]. This research study evaluated the bacteriological profile and antibiotic susceptibility in patients with urinary tract infections.

METHODOLOGY

This retrospective study with a cross-sectional design was held at Dow University of Health Sciences, Karachi; we evaluated records of patients from January to December 2020 at the Department of Microbiology, Dow Diagnostic Reference and Research Laboratory, Karachi, who requested urine culture due to urinary tract infection.

Data was collected from the record in which all suggested urine cultures and sensitivity samples were included. Written approval was taken from the institutional review board with reference no IRB-2038/ DUHS/EXEMPTION/2021/631.

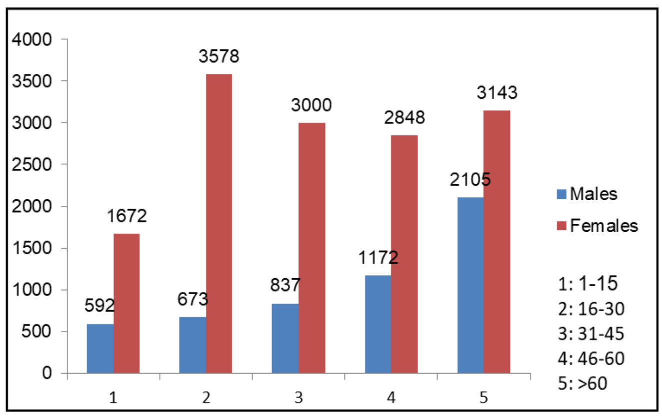
Midstream urinary specimen inoculated on Cystine lactose electrolyte deficient agar (CLED) agar (Oxoid) by colony count quantitative method using 0.001 ml loop by standard sterile Microbiological techniques. The plate was observed for any bacteria at 37°C incubation of 18 to 24 hours. If there were no growth, plates were re-incubated and re-assessed after 24 hours of incubation. The presence of 10^5 colony-forming units per millilitre reflected a substantial result. For documentation of bacterial morphology, Gram's stain and various biological test, including catalase test, Tube coagulase and bile esculin hydrolysis for Gram-positive bacteria. Ultimate validation was completed by API 20 E and API 20NE (bioMerieux France), as required[11]. Antimicrobial propensity analysis was performed using the Kirby-Bauer disk diffusion test procedure with 0.5 McFarland turbidity, Colony suspensions of the isolates on Mueller Hinton agar plates according to the Clinical and Laboratory Standards Institutes (CLSI) guidelines. An exclusion criterion encompasses duplicate samples, catheter specimens and incomplete information was fulfilled.

Oxoid®, UK and Bioanalyse®, Turkey, provided the antimicrobial discs. The tested Antimicrobials were: Amikicin (30 µg), Gentamicin (10µg), Ampicillin (10 µg), Amoxiclav (20/10 µg), Cefuroxime (30ug), Ceftriaxone (30 µg), Cefixime (5ug), Ceftazadime (30 µg), Pipracillin Tazobactam (100/10µg), Meropenem (10µg), Levoflaxacin (5ug), Ciprofloxacin (5ug), Nitrofurantoin (300ug), Fosfomycin (200ug), Colistin (10ug), Trimethoprim/ Sulphamethoxazole (1.25/23.75µg), tigecycline (15ug), linezolid (30ug), Vancomycin (30ug). The plates were incubated at 37° C for up to 16 hours. Diameters of the inhibitory zones were computed and noted.[1] SPSS version 20 was employed for data analysis. Rates and proportions were calculated for variables.

RESULTS

A total of 57785 samples were collected, of which 19620 were positive, 32254 showed no bacterial growth, 5670 had insignificant bacterial growth, and 241 had mixed bacterial growth. Among positive cases, 5379 were males, and 14241 were females. The mean age was 43.16 years, with a minimum age of one year and a maximum of 106 years old. The highest prevalence of Urinary tract infections was observed in Females of ages between 16 to 30 years of age as compared to males. In our study, males exhibited a high incidence of urinary tract infection rates after age 60. (**Figure I**)

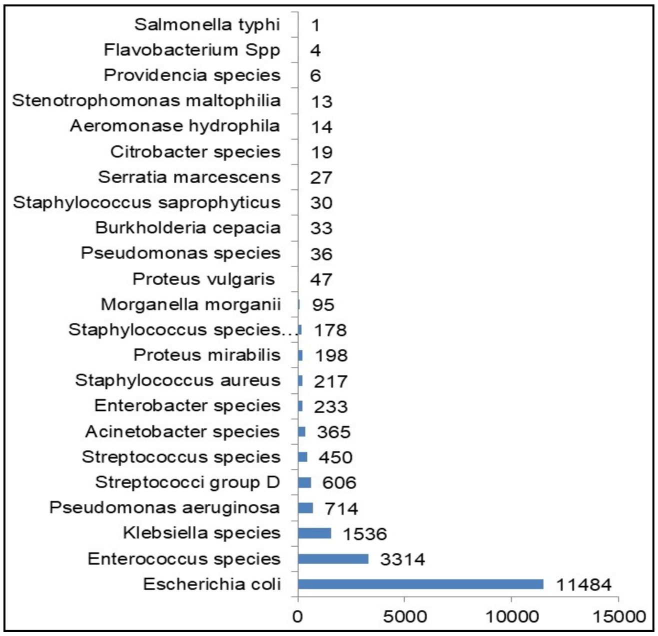
FIGURE I: GENDER AND AGE DISTRIBUTION OF URINARY TRACT INFECTION



Blue color lines show males, whereas red color lines show females. The X-axis has age intervals, whereas the Y-axis indicates the number of patients.

A total of 19620 bacterial pathogens that cause infection in the urinary tract were isolated, of which 14825 (75.6%) were Gram-negative, and 4795(24.4%) were Gram-positive. *E.coli* (11484, 58.5%) was among the most prevalent organisms, followed by Enterococcus species (3314, 16.8%), *Klebsiella species* (1536, 7.8%), *Pseudomonas aeruginosa* (714, 3.6%), *Streptococci group D* (606, 3.0%) and *Streptococcus species* (450, 2.2%). (**Figure II**)

FIGURE II: PATHOGENS THAT CAUSE URINARY TRACT INFECTION



The X-axis show the number of patients, and Y-axis show different bacteria.

E.coli is the dominant pathogen that affects all age groups and both genders. *Klebsiella, Acinatobacter, Enterobacter* and *Proteus* primarily affect patients 60 years and above.

Antibiotic susceptibility pattern showed the susceptible and resistant antibiotics for the above-isolated organisms. The most resistant drugs observed in our study were cefixime and cefuroxime, each showing 70.1% resistance, followed by ampicillin (65.4%) and Cotrimoxazole (64.3%). The most sensitive and minor resistant drug against isolates is Colistin (0.08% resistant), followed by Amikacin (4.9% resistant) and nitrofurantion (7.6% resistant). Enterococcus species showed a 67% resistant pattern against Levofloxacin, followed by vancomycin having 22 % resistance, whereas linezolid has a 100% sensitive pattern. In the case of *Klebseilla* highest susceptible and resistant drugs were Colistin (100%) and Levofloxacin (47.9%), respectively. Meropenum has shown 35.8% resistance, while Colistin was 100% susceptible against *Pseudomonas aeruginosa. Streptococcus species* had 43.3% resistance against Levofloxacin,

TABLE I: ANTIBIOTIC SUSCEPTIBILITY PATTERN OF BACTERIA ISOLATED FROM URINE CULTURES

Antibiotics	Esche-richia coli n=11484	Enterococ-cus species n=3314	Klebsiella species n=1536	Pseudomonas aeruginosa n=714	Strepto-coccus group D n=606	Strepto-coccus species n=450	Acineto-bacter species n=365	Enterobacter species n=233	Staph. aureus n=217	Proteus mirabilis n=198
AK	5.2 %	NA	18.4%	23.6%	NA	NA	15.8%	6.6%	2%	5%
CN	26.6 %	NA	16.8%	22.5%	NA	NA	18.9%	15.8%	19.7%	22%
AMP	86.6%	14.6%	NA	NA	1.3%	0.2%	NA	NA	NA	74.8%
AMC	35%	NA	36%	NA	NT	NT	NA	NA	NA	32.4%
TZP	12.1%	NA	12.4%	12.3%	NA	NA	11.3%	9.4%	NA	3.6%
CFM	73.9%	NA	46.7%	NA	NA	NT	NT	53%	NA	56.6%
CAZ	NA	NA	NA	18.3%	NA	NA	NA	NA	NA	NA
CRO	68.8%	NA	38.2%	NA	NA	0.4%	58%	34.5%	NA	41.4%
CXM	73.8%	NA	46.6%	NA	NA	NA	NA	53.4%	NA	57.3%
MEM	8.6%	NA	25.8%	35.8%	NA	NA	16.4%	10.9%	NA	3.4%
FOS	7.98%	4.7%	12.98%	NA	1.3%	0.7%	NA	19.7%	NA	34.9%
F	6.3%	5.9%	19.6%	NA	1	0%	5.9%	30.2%	NA	NA
LEV	64.5%	67.5%	47.9%	60%	48.3%	21.8%	47%	24.4%	NT	27.7%
CIP	63.4%	NT	33.1%	27.6%	NT	NA	28.6%	17.2%	NT	46.8%
CT	0%	NA	0%	0%	NA	NA	0%	0%	NA	NA
SXT	56.5%	NA	41.7%	NA	NA	52.1%	39.1%	30.9%	29.5%	79.8%
Clox	NA	NA	NA	NA	NA	NA	NA	NA	48.4%	NA
VA	NA	22%	NA	NA	0%	0%	NA	NA	0%	NA
LZD	NA	0%	NA	NA	0%	0%	NA	NA	0%	NA

AK: Amikacin, CN: Gentamicin, AMP: Ampicillin, AMC: Amoxicillin / Clavulanic acid, TZP: Piperacillin-tazobactam, CFM: Cefixime, CAZ: Ceftazidime, CRO: Ceftriaxone, CXM: Cefuroxime, MEM: Meropenem, FOS: Fosfomycin, F: Nitrofurantoin, LEV: Levofloxacin, CIP: Ciprofloxacin, CT: Colistin, SXT: Co-trimoxazole. Clox: Cloxacillin, VA: Vancomycin, LZD: Linezolid. NA: Not applicable NT: Not tested and 100% were sensitive to vancomycin and linezolid. All streptococcus species were 100% sensitive to linezolid, vancomycin and nitrofurantion. However, co-trimexazole was 52% resistant. Moreover, collectively *MRSA (Methicillin-resistant Staphylococcus aureus*), *MRSS (Methicillin-resistant Staphylococcus Strain*), *VRE (Vancomycin-resistant Enterococci*) and *CRE (Cabapenem resistant Enterobacteriaceae)* were observed in 48.4 %, 61.9%, 22% and 9.5%, respectively. (**Table I**)

DISCUSSION

This study helps improve the empirical treatment of patients infected with Urinary Tract infections. Recent studies aim to demonstrate urine culture's bacteriologic profile and antimicrobial susceptibility pattern. In our research, UTI is more prevalent in females, which is also shown by Gharavi et al. and Aamir et al.[12,13]. Females have a high UTI risk due to the shorter urethra, close vicinity to the rectum, improper hygiene and frequent sexual intercourse[14]. In our study highest prevalence of Urinary tract infections was observed in Females of ages between 16 to 30 years of age which is consistent with the study done in Kuwait[15] and Nigeria[16] but differs from the study reported in Japan[17] and India[18]. Males exhibited a high incidence of urinary tract infection rates after age 60, which is also shown by Gharavi et al.[13] but contrasting with the studies that had a higher incidence in childhood[19,20]. An increased incidence of UTI in males after 60 years might be due to prostate enlargement[21].

E.coli is the most frequently isolated organism in UTI samples, also reported in many studies[22,23]. *Klebsiella* is our study's second most common isolate, which was also observed in Ghorbani et al. and Kengne et al.[24,25]. In contrast to other studies, the subsequent quest isolate was *Enterococcus*[26] and *Staphylococcus aureus*[27]. *Acinatobacter, Enterobacter* and *Proteus* were also isolated in our study, which agrees with many studies[28-30].

We evaluated that cefixime and cefuroxime each showed the highest resistance, followed by ampicillin and Cotrimoxazole. In contrast, the most sensitive and minor resistant drug against isolates is Colistin, followed by Amikacin and nitrofurantion, by most the uro-pathogens. Compared to our study, Prakash & Saxena reported nalidixic acid was the most resistant drug, followed by Ceftazidime and cefotaxime, and they further reported meropenem is the most sensitive drug, followed by imipenem, Levofloxacin and netillin[9,18]. Yekani et al. reported trimethoprim/ sulfamethoxazole, ciprofloxacin, nalidixic acid, and Levofloxacin were more resistant, and fosfomycin and carbapenems (imipenem and meropenem and ertapenem)[31]. Against *E.coli* highest resistance was shown by pipercillin and ampicillin and increased sensitivity to Meropenem Imipenem, Amikacin, and Nitrofuranton by Mohammed et al., which contradicted our findings[30]. In our study, Meropenum and Colistin showed resistance and susceptibility against pseudomonas *aeruginosa. In contrast,* according to Prakash & Saxena, sparfloxacin and meropenem are the most resistant and susceptible drugs, respectively, in *Pseudomonas aurigenosa*[18]. *Klebsiella* showed the highest sensitivity to ciprofloxacin by Emamghorashi et al.[32] and resistant to Ceftazidime[18] whereas, as we observed, Klebseilla has high susceptibility and resistance were against Colistin (100%) and Levofloxacin (47.9%), respectively.

CONCLUSION

The present study contributes essential data to display and relate with other parallel studies to enumerate the recent trend of antimicrobial susceptibility of uro-pathogens and aids in determining empirical management and treatment plans for the patients of UTIs. Similar research should be designed on a large scale in diverse areas and regions. This would form empiric antibiotic therapy guidelines according to the local antimicrobial susceptibility pattern, which helps improve patient outcomes and judicious antibiotic use.

Ethical permission: Dow University of Health Sciences IRB letter No. IRB-2038/DUHS/ EXEMPTION/2021/631, dated: 29-12-2021.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publically.

AUTHOR CONTRIBUTIONS

Fatima A: Design & conception of idea, data interpretation, Final approval
Fasih F: Drafting manuscript, manuscript writing
Naseem S: Assembly of data, literature review
Sajjad M: Statistical analysis of data, manuscript writing
Gohar H: Literature review, referencing
Bukhari U: Critical review, final approval

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