Antibiotic Susceptibility Patterns of Bacteria Among Urinary Tract Infection Patients Attending Private Laboratories in Baghdad City

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Abstract
Background: Urinary tract infections (UTIs) are among the most common infections in the community. These infections are caused by the colonization of uro-pathogens into the urinary tract. The most common causative agents of UTI are Gram-negative bacteria most frequently by Escherichia coli. The emergence of antibiotic-resistant bacterial strains is a serious problem and greatest challenge in public health care necessitating constant antibiotic susceptibility screening for organisms causing UTI. Aim of the study: To assess the most frequent pathogens involved in urinary tract infections in two private laboratories in Baghdad City, and the antibiotic susceptibility of isolates. Materials and methods: One hundred twenty four urine samples received by the laboratories for culture and susceptibility testing over a period from December 2020 to June 2021were analyzed and included in this study. Antimicrobial susceptibility testing was done on cultured isolates.Results: Fifty-three samples 53/124(42.7%) had positive culture. Prevalence of bacterial UTIs were higher in the age group 30-39 with 15/53 (28.3%). The prevalence was higher in females (75.5%) compared to (24.5%) in males. Cultures revealed six bacterial pathogens of which Escherichia coli was the most prevalent isolate (60.4%), followed by Klebsiella spp (20.7%), Staphylococcus aureus (7.5%), Pseudomonas aeruginosa (5.7%), Proteus spp (3.8%) and streptococcal spp (1.9 %). The antibiotic sensitivity of pathogens isolated from positive urine cultures against the tested antibiotics showed highest rate to imipenem (98%) followed by amikacin (90%) and less to ciprofloxacine, nitrofurantoin while the lowest sensitivity were shown in co-trimoxazole (25%) and cefotaxime (20%). Conclusion: Treatment for UTIs should be determined based on antibiotic susceptibility patterns of uro-pathogens to minimise therapeutic failures and prevent antibiotic misuse.
Keywords: Antimicrobial susceptibility, Escherichia coli, urinary tract infections, uro-pathogens.

1. Introduction

Urinary tract infections (UTIs) are one of the most common bacterial infections worldwide. They are inflammatory disorders caused by microorganisms that grow in the urinary system (1). Symptoms of UTIs include frequent micturition, fever, dysuria, lower abdominal pain, and may result in loin pain (2). Some UTIs are asymptomatic or present with atypical signs and symptoms. Urinary tract infection is more common in women than in men because of the anatomical proximity of the urethra to anus (3).
The most prevalent bacteria causing UTI is Escherichia coli which is
alone responsible for 80% of the cases (1), followed by Klebsiella pneumoniae, Staphylococcus sp., Pseudomonas aeruginosa, Proteus sp., Enterococcus sp., and Enterobacter sp. with variations in their prevalence (4,5,6).
Approximately 150 million UTI cases each year are diagnosed globally (1,7).
Susceptibility data from microbiological laboratories assist in the selection of antibiotics for treatment. However, UTIs are empirically treated, particularly in areas where the facility of urine culture is unavailable, resulting in antibiotic misuse and an emerging threat of drug resistance (8). However, the increasing incidence of drug resistance among pathogens is considered as a significant public health concern, necessitating constant antibiotic susceptibility (AS) screening for organisms causing UTI. Knowing the resistance profile of uropathogenic bacteria is important in choosing an adequate treatment, the choice of antibiotics used should take into consideration antibiotic resistance patterns (9.). Appropriate antibiotic use in patients with UTI can reduce length of disease and therefore favors patient outcomes and healthcare costs.[5] thus, it becomes important to monitor regularly the susceptibility patterns of uro-pathogens, so that empirical antibiotic therapy guidelines can be improved to choose antibiotics with low resistance, aiding clinicians in proper management of UTIs with minimal therapeutic failures (5).
This study aims at assessing the most frequent pathogens involved in urinary tract infections in private labs in Baghdad City, and the antibiotic susceptibility of isolates.

2. Materials and Methods

Urine samples were collected from 124 patients from 2 private laboratories in Hay-Alkhathraa Baghdad during the period from December 2020 to June 2021.
The study included adult patients attending clinics, who were confirmed to have UTI symptoms and

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signs by the clinician. All the patients had no history of antimicrobial drug administration for UTIs in the last two weeks.

Midstream urine samples were collected from patients. Urine sample passes through the distal urethra can become contaminated with bacteria. A procedure have been developed to decrease the contamination that cleansing of skin and mucous membranes adjacent to the urethral orifice before micturition, and allowing the first part of the urine stream to pass into the toilet, then collecting urine for culture from the midstream (10) .

The samples were collected in sterile urine containers and analyzed in a period not more than 2 hours in order to avoid the contamination of bacteria in the urine.

Each sample of midstream urine was inoculated in Cystine Lactose Electrolyte Deficient (CLED agar) and incubated at 37°C for 24 h (11) After incubation, cultures were sub-cultured on blood agar and macConkey agar media, positive UTI was recorded according to the appearance of 100,000 Colony Forming Units (CFU) per milliliter on blood, macConkey agar (12). Identification of bacteria was established based on their gram staining and cultural morphological characteristics.

The data was analyzed using SPSS version 24 and presented in tables and diagrams.

3. Results

A total of 124 patients were included in the study, out of which 80 (68.5%) were females and 44 (35.5%) were males.

Fifty-three samples 53/124(42.7%) had positive culture and 57.3% with no growth. Prevalence of bacterial UTIs were higher in the age group 30-39 with 15/53 (28.3%), compared to the group of more than 60 years that had the lowest value 6/53 (11.3%) (Table 1). The prevalence of UTIs were significantly higher in females 40/53(75.5%) compared to 13/53(24.5%) in males (P value =0.0009).

Table 1- Prevalence of urinary tract infections with positive isolate according to age and sex of patients

Age groups (y)	Female n (%)	Male n (%)	Total n (%)
15-29	8 (15.1)	1 (1.9)	9 (17.0)
30-39	10 (18.9)	5 (9.4)	15 (28.3)
40-49	9 (17.0)	4 (7.5)	13 (24.5)
50-59	8 (15.1)	2 (3.8)	10 (18.9)
60+	5 (9.4)	1 (1.9)	6 (11.3)
Total	40 (75.5)	13 (24.5)	53 (100)

Samples were inoculated and tested against the following antibiotics:

Amikacin, levofloxacin, ceftazidime, ceftriaxone, ciprofloxacin, cefotaxime, erythromycin, gentamycin, amoxyclave, nalidixic acid, nitrofurantoin, and imipenem.

Table 2 shows six bacterial pathogens isolated from 53 midstream urine samples of which Escherichia coli was the most prevalent isolate 32/53 (60.4%), followed by Klebsiella spp 11/53 (20.7%), Staphylococcus aureus 4/53 (7.5%), Pseudomonas aeruginosa 3/53 (5.7%), Proteus spp 2/53 (3.8%) and streptococcal spp 1/53 (1.9 %)

Table 2- Prevalence of bacterial uropathogen isolates from patients (n= 124)

Pathogen	Female n (%)	Male n (%)	Total n (%)
Escherichia coli	22 (41.5)	10 (18.8)	32 (60.4)
Klebsiella spp	9 (17.0)	2 (3.8)	11 (20.7)
Staphylococcus aureus	3 (5.7)	1 (1.9)	4 (7.5)
Pseudomonas aeruginosa	3 (5.7)	0 (0.0)	3 (5.7)
Proteus spp	2 (3.7)	0 (0.0)	2 (3.8)
streptococcal spp	1 (1.9)	0 (0.0)	1 (1.9)
Total	40 (75.5)	13 (24.5)	53 (100)

Regarding antibiotic sensitivity pattern, the pathogens showed more sensitivity to imipenem (98%) followed by amikacin(90%) and less to ciprofloxacine, nitrofurantoin while the lowest sensitivity were shown in co-trimoxazole(25% sensitive) and cefotaxime(20% sensitive) (Table 3)

Table 3- Antibiotic sensitivity rate (%) of pathogens isolated from positive urine cultures against the tested antibiotics.

Antibiotic	Sensitivity rate
Imipenem	98%
Amikacin	90%
Ciprofloxacine	77%
Nitrofuranton	70%
Co-trimoxazole	25%
Cefotaxime	20%

Since Escherichia coli was found to be the predominant cause of UTI among the isolates with 60.4%, culture and sensitivity were collected for mostly used antibiotics. The highest percentage of

sensitivity of E coli was to imipenem (100% sensitive) followed by amikacin (96% sensitive), nitrofuranton (88%), followed by Gentamycin (55%), ceftriaxone (42%), ciprofloxacin (40%), levofloxacin (31%). Less sensitivity was shown to Amoxyclav, Co-trimoxazole (15% each) and 4% for Cefotaxime. (Table 4)

Table 4- Antibiotic sensitivity rate (%) of E coli isolated from positive urine cultures against the tested antibiotics.

Antibiotic	Sensitivity rate (%)
Imipenem	100
Amikacin	96
Nitrofuranton	88
Gentamycine	55
Ceftrixone	42
Ciprofloxacine	40
Levofloxacine	31
Co-trimoxazole	15
Amoxyclave	15

For proteus Spp. amikacin, ciprofloxacin and cotrimoxazole show the highest sensitivity percent, for Staphylococcus aureus Spp. Imipenem, nitrofurantoin, amikacin and doxycyclin show the greatest sensitivity percent. While for Pseudomonas Spp. and Klebsiella Spp, amikacin, imipenem, levofloxacin and ciprofloxacin have the highest activity.

4. Discussion

Urinary tract infection is a frequent disease that many people complain of, mainly females. The present study showed the prevalence rate of bacterial urinary tract infection was 53/124(42.7%). Similar findings have been reported in a previous study conducted in Al-Karkh Surgery Hospital in Baghdad City, 125/311(40.19%) (13); and in Mulago hospital, Uganda, 54/139(38.8%) (14).

In Algeria, 35.53% were found to be positive for UTI (15). However, it is higher than that reported in Medical City Hospital in Baghdad 63/237 (26.58%) (16).

And in Erbil City 110/500(22%) by (17); in Bangladesh it was 507/1957 (25.91%) (18); and in Oman 155/559(27.73%) (19). In this study, the prevalence of UTIs was found to be much higher than Saudi Arabia, 763/7154(10.67%) (20) . Ethiopia, 21/228(9.2%) (21); and in Iran 553/7056(7.8%) (22).

However, it is lower than the prevalence in North Indi (77.9%) reported recently 2022 (23).

The difference in our results with other studies may be due to either a variation in sample size, region, or community customs and traditions, personal hygiene level, or education level.

The prevalence of UTI among females was 75.5% compared to 24.5% among males. This result is in agreement with a study done in Medical City Hospital in Baghdad which reported that prevalence of UTI in females was 49/63(77.78%) as compared to 14/63(22.22%) in men (16). Other reports also showed that UTIs are much more common in women than men (24,25).

Females are more prone to UTI due to short and straight urethra and short distance between urethra and anus which contribute to easy colonization of the urethral region with enteric bacteria. Adding to that UTIs may result following sexual intercourse, during which bacteria may introduce to the urethra [26).

Regarding age, this study found the highest rate was among age group 30-39 (28.3%) which is in agreement with Medical City Hospital Baghdad study (16) (23.81%).

UTIs are caused by a variety of microorganisms, E. coli was the most predominant bacteria with (60.4%). This is in agreement with a study done in Lebnon (60 %) (27) and with Baghdad study (16). Many studies in different countries found that E.coli is the most prominent cause of UTIs. Arul Prakasam et al showed that E.coli (83.8%) was the most prevalent pathogen causing UTI in Kerala (24), Bhargava K et al reported that E. coli was the most predominant gram-negative bacteria, accounting for 54.95% of all isolates (23) , furthermore E coli accounted for over 90% of the isolates in many previous reports (28,29).

Ait-Mimoune N et al in Algeria reported that E. coli and K. pneumoniae were the most isolated bacterial species (15).The third most isolated bacterial uropathogen was Staphylococcus aureus (7.5%) which is less than that reported in other Iraq studies in Baghdad and Erbil (15.8%), (15.2) respectively (16,17).

A low prevalence was seen with other bacteria like Pseudomonas aeruginosa (5.7%) and Proteus spp (3.8%). this result is in agreement with other studies done about the UTI in community, which showed that the lowest recovered pathogens were Pseudomonas aeruginosa and Proteus spp (16,17, 21).

The least prevalence found within the study was Streptococcus
spp. (1.9%) which is in agreement with Basrah study (25).

The sensitivity to antibiotics in UTIs varies according to the type of bacteria, with E. coli, the use of Imipenem, amikacin and nitrofurantoin, showed higher sensitivity rate. while Amikacin, imipenem and ciprofloxacin are effective against Klebsiella spp. and Pseudomonas spp. Co-timoxazole, ciprofloxacine, and amikacin are very effective against Proteus spp. Basrah study reported similar sensitivity pattern as this study (25).

In conclusion, the prevalence of UTI in this study was higher than reported by previous studies done in Iraq, thus treatment should be determined based on antibiotic susceptibility patterns of pathogens to minimise therapeutic failures and prevent antibiotic misuse.

References

Malik, S., Rana, J. S., and Nehra, K. Prevalence and antibiotic susceptibility pattern of uropathogenic Escherichia coli strains in Sonipat region of Haryana in India. 2021.Biomed. Biotechnol. Res. J. 5, 80–87.

Leung, A. K., Wong, A. H., Leung, A. A., and Hon, K. L. Urinary tract infection in children. 2019. Recent Pat. Inflamm. Allergy Drug Discov. 13, 2–18.

Fazly Bazzaz, B. S., Fork, S. D., Ahmadi, R., and Khameneh, B. Deep insights into urinary tract infections and effective natural remedies. 2021. Afr. J. Urol. 27, 1–13.

Ahmed, S. S., Shariq, A., Alsalloom, A. A., Babikir, I. H., and Alhomoud, B. N. Uropathogens and their antimicrobial resistance patterns: Relationship with urinary tract infections. 2019. Int. J. Health Sci. 13, 48–55.;

Patel, H. B., Soni, S. T., Bhagyalaxmi, A., and Patel, N. M. Causative agents of urinary tract infections and their antimicrobial susceptibility patterns at a referral center in Western India: An audit to help clinicians prevent antibiotic misuse. 2019. J. Fam. Med. Prim. Care 8, 154–159.

Mukherjee, S., Mishra, S., and Tiwari, S. Aetiological Profile and Antibiogram of Urinary Isolates Causing UTI in Patients Attending a Tertiary Care Hospital of Western Odisha. 2020. J. Evol. Med. Dent. Sci. 9, 662–667.).

Flores-Mireles, A. L., Walker, J. N., Caparon, M., and Hultgren, S. J.Urinary tract infections: Epidemiology, mechanisms of infection and treatment options. 2015. Nat. Rev. Microbiol. 13, 269–284.

Al-Zahrani, J., Al Dossari, K., Gabr, A. H., Ahmed, A. F., Al Shahrani, S. A., and Al-Ghamdi, S. Antimicrobial resistance patterns of Uropathogens isolated from adult women with acute uncomplicated cystitis. 2019. BMC Microbiol. 19:237.

Kot, B. Antibiotic Resistance Among Uropathogenic Escherichia coli. 2019. Pol. J. Microbiol. 68, 403–415.

Clarridge JE, Johnson JR, Pezzlo MT. Cumitech 2B: laboratory diagnosis of urinary tract infections. Washington, DC: American Society for Microbiology, 1998.

Cheesbrough, M., 2009. Biochemical Tests to Identify Bacteria. In: District Laboratory Practice in Tropical Countries, Cambridge University Press, New York, pp: 45-58.

Harding, G.K., G.G. Zhanel, L.E. Nicolle and M. Cheang, 2002. Antimicrobial treatment in diabetic women with asymptomatic bacteriuria. New Engl. J. Med., 347: 1576-1583.

Kareem, I.K. and I.Y. Rasheed, Antibiotic susceptibilities of gram-negative aerobic bacteria isolated from urinary tract infections in community. 2011. Iraqi J. Med. Sci., 9: 295-300.

Kabugo, D., S. Kizito, D.D. Ashok, A.G. Kiwanuka and R. Nabimba et al., Factors associated with community-acquired urinary tract infections among adults attending assessment centre, Mulago Hospital Uganda. 2016. African Health Sci., 16: 1131-1142.

Ait-Mimoune N, Hassaine H, Boulanoir M. Bacteriological profile of urinary tract infections and antibiotic susceptibility of Escherichia coli in Algeria. Iranian Journal of microbiology. 2022; 14 (2): 156-160).

Fadhl A.S. Al-Gasha'a, Shayma M. Al-Baker, Jamil M. Obiad and Fadhil A. Prevalence of Urinary Tract Infections and Associated Risk Factors Among Patients Attending Medical City Hospital in Baghdad City, Iraq. American Journal of Infectious Diseases 2020, 16 (2): 77-84.

Alsamarai, A.M., I.A. Latif and M.M. AbdulAziz, Urinary tract infection in Iraq: Evaluation of early detection methods and etiology. 2016. World J. Pharmacy Pharm. Sci., 5: 181-194.

Chowdhury, S. and R. Parial, Antibiotic susceptibility patterns of bacteria among urinary tract infection patients in Chittagong, Bangladesh. 2015. SMU Med. J., 2: 114-125.

Hassali, M.A., A. Alrawhi and A. Nouri, Antibiotic sensitivity pattern in urinary tract infections at a secondary care hospital in Oman. 2018.Acta Scientific Med. Sci., 2: 02-06.

Akbar, D.H., Urinary tract infection: Diabetics and non-diabetic patients. 2001.Saudi Med. J., 22: 326-329.

Beyene, G. and W. Tsegaye, Bacterial uropathogens in urinary tract infection and antibiotic susceptibility pattern in Jimma university specialized hospital, Southwest Ethiopia. Ethiop. 2011. J. Health Sci., 21: 141-146.

Amin, M., M. Mehdinejad and Z. Pourdangchi, Study of bacteria isolated from urinary tract infections and determination of their susceptibility to antibiotics. 2009. Jundishapur J. Microbiol., 2: 118-123.

Bhargava K, Nath G, Bhargav A, Kumari R,. Aseri GK and Jain N. Bacterial profile and antibiotic susceptibility pattern of uropathogens causing urinary tract infection in the eastern part of Northern India. Frontiers in Microbiology. 2022; 10.3389/fmicb.2022.965053.

Arul Prakasam, K.C.; Dileesh Kumar, K. G. and Vijayan, M.A .Cross sectional study on distribution of urinary tract infection and their antibiotic utilisation pattern in Kerala. Int. J. Pharm.Tech Res. 2012. Vol. 4 (3). Pp: 1309-1316.

Hadi AM, Hasan F, Sheri FH and Jaccob AA. Urinary Tract Infection Prevalence and Antibiotic Resistance A Retrospective Study in Basra Governorate, Iraq. AJPS, 2014; 14(2): 129-135.

Foxman, B. and Frerichs, R. R. Epidemiology of Urinary Tract Infection: 1. Diaphragm Use and Sexual Intercourse. A J P H November 1985. Vol. 75 (11).

Daoud Z, Afif C. Escherichia coli isolated from urinary tract infections of Lebanese patients between 2000

and 2009: epidemiology and profiles of resistance. Chemother Res Pract 2011; 2011: 218431.
Larcombe, J. Urinary tract infection in children. BMJ. 1999. Vol. 319. Pp: 1173–50).
Royal College of Physicians. Report of a Working Group of the Research Unit, Royal College of Physicians. Guidelines for the management of acute urinary tract infection in childhood. J R CollPhys Lond. 1991. Vol.25. Pp: 36–42.