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ORIGINAL RESEARCH

Prevalence of Bacterial Urinary Tract Infection, Associated Risk Factors, and Antimicrobial Resistance Pattern in Addis Ababa, Ethiopia: A Cross-Sectional Study

Yosef Gebretensaie[1,*], Abay Atnafu[2,*], Selfu Girma[2], Yonas Alemu[3], Kassu Desta[1,*]

[1]Department of Medical Laboratory Science, Addis Ababa University, Addis Ababa, Ethiopia; [2]Mycobacterial Disease Research Directorate, Armauer Hansen Research Institute, Addis Ababa, Ethiopia; [3]Department of Microbiology, Immunology, and Parasitology, College of Health Science, Addis Ababa University, Addis Ababa, Ethiopia

*These authors contributed equally to this work

Correspondence: Yosef Gebretensaie, Tel +251913063450, Email yoseftakelove@gmail.com

Background: Urinary tract infections (UTIs) brought a significant and serious health-related problem that may lead to the subsequent development of serious indications with the challenge of the emergence of antibiotic resistance. Therefore, the choice of antibiotics depends on the accuracy of the diagnostic tool of UTIs to minimize false results that may subject patients to wrong treatments. This study aimed to determine the prevalence of bacteriuria, associated factors, and AMR pattern of UTI-suspected patients.

Methods: A cross-sectional study was conducted from March to May 2022, at Arsho Advanced Medical Laboratory (AAML), Addis Ababa, Ethiopia. Species identification and isolation from bacterial colonies were characterized by gram stain and biochemical properties followed by antibiotic susceptibility testing using the Kirby-Bauer method on Muller-Hinton agar. Logistic regression analysis was carried out to determine the association between the independent variables and significant bacterial growth to identify factors that affect the prevalence of UTI. A test is considered statistically significant that has a P value less than 0.05.

Results: Out of 141 (31.6%) which yielded significant bacteriuria, 16 different species of bacterial uropathogens were identified. A total of 105/446 (91 Gram-negative and 14 Gram-positive) of bacterial growth in the female gender and 36/446 (33 Gram-negative and 3 Gram positive) in male were observed with a P value of 0.03. The most predominant bacteria were *E. coli* followed by *Klebsiella pneumoniae*. Amoxicillin had shown the highest resistance rate (100%) followed by Ampicillin (98.9%). Females and participants with previous infections were shown to be associated with significant bacterial growth.

Conclusion: Based on our study finding, the ordinarily used antibiotics seem to face emerging resistant strains, which needs considerable and due attention to the impact of UTI in developing countries including Ethiopia. History of previous UTIs and female gender were shown to be possible risk factors associated with UTIs.

Keywords: prevalence, uropathogen, urinary tract infection, antimicrobial resistance pattern

Introduction

Urinary tract infection (UTI) is commonly caused by bacterial pathogens that often affect the urinary system including the kidney, ureters, bladder, and urethra. The bacterial pathogens invade the urinary tract involving the lower and the upper urinary tract and may sometimes spread to the bloodstream resulting in several clinical syndromes such as fever, flank pain, dysuria and hematuria classified as cystitis (bladder infection), and pyelonephritis (kidney infection).[1] Morbidity and mortality associated with UTI were shown to be 150 million cases globally per year.[2] In other instances, UTI may be presented as asymptomatic, where according to one report the prevalence was shown to be 0.37% and 0.47% in boys and girls, respectively. A 3% prevalence of asymptomatic Bacteriuria in women was also reported in another study.[3,4] Of note, a considerable proportion of the recurrent UTIs in children,

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a rate of 30%, was reported by one study. Another report has also shown a recurrence rate of 19–22% among children younger than 16 years of age.[4–6]

Urinary tract infections affecting the kidney brought a significant and serious health-related problem[7,8] in all sex and age groups but especially women are at high risk for developing UTI than men due to the anatomical structure and shorter distance of the urethra.[9] UTIs are listed among the most common infectious diseases that impacted the financial burden on society, more importantly in young women and also the incidence of UTI increased with age exceeding from 65 years.[10] *Escherichia coli* was reported to be the major bacterial isolate found in UTI from non-compromised children or adults with acute non-obstructive pyelonephritis.[11] On another note, urethral catheterization, those undergoing urological surgery and manipulations, long-stay elderly male patients, and patients with debilitating diseases are reported to be at high risk of developing nosocomial UTI.[12]

The most frequent causative agent of UTI is bacteria where aerobic Gram-negative bacilli have a predominant contribution. In addition, Gram-positive cocci also contribute to a considerable portion of UTIs.[13] *Escherichia coli*, the most prevalent community-acquired UTI, accounts for 70–95% of acute and uncomplicated UTIs in adults, followed by *Proteus mirabilis*, *Klebsiella* spp., and *Staphylococcus saprophyticus* accounts for 5–10% of the cases collectively. On the other hand, secondary pathogens such as *Pseudomonas* is mostly seen in complicated UTI. Additionally, a small fraction of UTIs can have a hematogenous origin with relatively uncommon microorganisms (like *Staphylococcus aureus*, *Candida* spp., *Salmonella* spp., and Mycobacterium tuberculosis).[7,14] Moreover, 90% of UTI causative agents were reported from gram-negative bacteria while the rest 10% of the cases were from gram-positive bacteria.[15]

In a setting where there is an intake of antibiotic without prescription, antimicrobial susceptibility testing is considered a crucial technique to investigate and decide the appropriate treatment regime along with pathological identification via evaluating and measuring the halos of inhibition around disks according to the standard reference tables which create a great insight into an overall antimicrobial susceptibility profile.[7,16]

This study aimed to determine the prevalence of UTI associated with bacteriuria, associated risk factors, and antimicrobial resistance patterns of uropathogens among suspected patients attending AAML, Addis Ababa, Ethiopia.

Methods

Study Setting

An institution-based cross-sectional study was conducted at Arsho Advanced Medical Laboratory (one of the largest advanced medical laboratories in center of Addis Ababa) from March to May 2022. The laboratory is a privately owned advanced laboratory extending its service to a wide range of patients who have been referred for a wide array of laboratory tests which are not delivered from the referring health facilities due to various reasons. The laboratory serves approximately 10 patients per day who have been referred to urine culture testing. A convenient sampling technique was used and a total number of 446 study participants suspicious of having UTI were enrolled in this study. All patients referred to AAML from several health facilities across Addis Ababa town for UTI culture testing were enrolled in this study. Patients not willing to participate were excluded from the study. A total of 36 participants were unable to consent. The patient's consent was asked for participation after a brief explanation, following explanation written consent form for each participant and for those participants under 18 years, a parent or guardian consent was obtained, and then a structured data collection format was used to collect sociodemographic data. Data were entered and statistically analyzed using SPSS version 26.0 software. Binary Logistic regression analysis was carried out to determine the association between the independent variables and significant bacterial growth to identify factors that affect the prevalence of UTI. Multivariate logistic regression with a 95% confidence interval was used in this study to assess the association between variables. A test is considered statistically significant when a P value is less than 0.05. An ethical clearance which complies with declaration of Helsinki was obtained from the Department of Research and Ethical Review Committee (DRERC) of the Department of Medical Laboratory Sciences, College of Health Sciences, Addis Ababa University. The respondents have the right to refuse or to take part in the study and withdraw at any time during the study period. All the information obtained from the study subjects was coded to maintain confidentiality.

Laboratory Procedures

Sample Collection

To reduce the risk of contamination, participants, following their arrival at the laboratory, were informed to clean their hands and genital area using water and swab soaked in normal saline which was given to each participant. The clean catch mid-stream urine samples were collected using a sterile, wide-mouthed urine cup and processed in the microbiology laboratory as soon as they arrived.

Urine Sample Processing

The urine sample collected from each patient was inoculated onto Blood Agar Base (Oxoid, Basingstoke, Hampaire, UK) and on MacConkey Agar (Oxoid, Basingstoke, Hampaire, UK) using a 10μL calibrated loop. It was then incubated at 37°C for 18–24 hours aerobically. The number of colonies was counted and a yield of bacterial growth > 10^5 CFU/mL of urine was considered significant for bacteriuria. Pure isolates of the bacterial pathogen were preliminarily characterized by colony morphology, gram stain, and biochemical test before performing AST procedures. The preparation and performance evaluation of culture media was performed as per the instruction of the manufacturer's guidance.

Antimicrobial Susceptibility Testing

Antimicrobial Susceptibility testing was performed on isolates according to the criteria of the Clinical and Laboratory Standards Institute (CLSI, 2021) using the Kirby–Bauer disc diffusion method on Muller-Hinton Agar (Oxoid, Basingstoke, Hampshire, UK). After overnight incubation, a sterile swab was dipped into the growth suspension and the excess inoculum was removed by pressing it against the sides of the tube. The swab was then applied to the center of a 150mm sized Muller Hinton agar plate (Oxoid, Basingstoke, and Hampshire, UK) and evenly spread on the medium, and antibiotic disks were placed after 15 minutes of inoculation at Muller Hinton agar in 15mm and 24mm distance from the edge and each other respectively. The diameter of the zone of inhibition around the disc was measured using a sliding metal caliper. The isolates were categorized as sensitive (S), resistant (R), or intermediate (I) based on the inhibition zone they produced around the antibiotics used. The break point (BP) used for S/I/R categorization was CLSI 2021 M100 31st. The drugs that were used in the susceptibility test are Amoxicillin, Ampicillin, Augmentin, Ampicillin/Sulbactam, Cefazolin, Cephalothin, Cefuroxime, Cefotaxime, Ceftazidime, Doxycycline, Gentamycin, Ciprofloxacin, Levofloxacin, Moxifloxacin, Nitrofurantoin, Norfloxacin, Tetracycline, Trimethoprim/Sulfamethoxazole for both Gram-negative and gram-positive bacteria. In addition, drugs such as Piperacillin/Tazobactam, Cefoxitin, Cefixime, Ceftriaxone, Meropenem, Amikacin, Gentamicin, Tobramycin, and Meropenem were used for gram-negative bacteria, whereas Linezolid, Benzylpenicillin, Moxifloxacin, Methicillin, Tetracycline, and Vancomycin were used for gram-positive bacteria.

Results

Socio-Demographic Characteristics and the Prevalence of Urinary Tract Infection (UTI)

Four hundred and forty-six (446) patients presenting or highly suspicious of having UTIs were recruited in the study upon obtaining informed consent and have met the selection criteria. The prevalence of UTI was 141/446 (31.6%) by the conventional culture method. A pick value of 27/141 (19.14%) and 30/141 (21.27%) were observed in the adult age group of 20–39, respectively. An increased prevalence of UTI was observed in females with 105/293 (35.8%) as compared to men with 39/153 (23.5%) (Table 1).

Association of the Prevalence of Bacteriuria with Their Clinical Presentation

Of the total participants, 98 (22.0%), 222 (49.8%), 321 (72.0%), 310 (69.5%), 221 (49.6%), and 245 (54.9%) of them showed dysuria, increased frequency, urgency, hematuria/abdominal discomfort/supra-pubic pain, fever/chill, and flank pain, respectively. Many clinical symptoms such as increased frequency, urgency, hematuria/abdominal discomfort/ supra-pubic pain, and fever/chill have shown significant relationships with UTI ($P < 0.05$). According to clinical investigation, out of the total study participant, 33 (7.4%) were shown to have previous usage of catheters and 51 (11.4%) had been previously exposed to UTI cases, of which 12/51 (23.5%), and 39/51 (76.5%) had expressed within the last three years and one year, respectively (Supplementary Table 1).

Table 1 Factors Associated with Bacterial Growth at Arsho Advanced Medical Laboratory from March, 08–May 20, 2021

Variables	Significant Bacterial Growth		COR (95% CI)	AOR (95% CI)	P value
	No Growth (%)	Significant Bacterial Growth (%)			
Sex					0.030*
Female	188(64.2%)	105(35.8%)	1.815(1.165–2.828)	1.832(1.059–3.168)	
Male	117 (76.5%)	36 (23.5%)	1	1	
Age category					0.011*
0–19	33 (67.3%)	16 (32.7%)	0.416 (0.157–1.102)	0.721 (0.222–2.335)	0.585
20–39	117 (67.2%)	57 (32.8%)	0.418 (0.181–0.961)	0.579 (0.206–1.630)	0.301
40–59	78 (78%)	22 (22%)	0.242 (0.098–0.597)	0.223 (0.071–0.704)	0.011*
60–79	65 (67%)	32 (33%)	0.422 (0.175–1.017)	0.413 (0.140–1.220)	0.109
≥80	12 (46.1%)	14 (53.9%)	1		
Increased frequency					0.002*
No increased frequency	178 (79.4%)	46 (20.6%)	0.345 (0.227–0.525)	0.452 (0.274–0.744)	
Increased frequency	127 (57.2%)	95 (42.8%)	1	1	
Urgency					<0.001*
No urgency	59 (47.2%)	66 (52.8%)	3.669 (2.372–5.675)	4.531 (2.698–7.609)	
Urgency	246 (76.6%)	75 (23.4%)	1	1	
Hematuria and/or Abdominal discomfort (super-pubic pain)					0.036*
No hematuria and/or Abdominal discomfort (super-pubic pain)	104 (76.5%)	32 (23.5%)	0.567 (0.358–0.899)	0.553 (0.318–0.963)	
Hematuria and/or Abdominal discomfort (super-pubic pain)	201 (65%)	109 (35%)	1	1	
Fever and chill					0.149
No Fever and chill	167 (74.2%)	58 (25.8%)	0.577 (0.385–0.865)	0.699(0.429–1.137)	
Fever and chill	138 (62.4%)	83 (37.6%)	1	1	
History of previous UTI					<0.001*
No History of previous UTI	297 (75.2%)	98 (24.8%)	0.061 (0.028–0.135)	0.027 (0.008–0.100)	
History of previous UTI	8 (15.7%)	43 (84.3%)	1	1	
History of UTI for the Last three years					0.010*
No History of UTI for the last three years	300 (69.1%)	134 (30.9%)	0.319 (0.099–1.023)	0.087 (0.013–0.562)	
History of UTI for the last three years	5 (41.6%)	7 (58.4%)	1	1	
History of catheterization					0.807
No History of catheterization	289 (70%)	124 (30%)	0.404 (0.198–0.825)	1.125 (0.437–2.899)	
History of catheterization	16 (48.5%)	17 (51.5%)	1	1	

Note: *Statistically significant.

Factors Contributing to the Prevalence of Urinary Tract Infections

Binary logistic regression analysis was carried out to determine the association between the independent variables and significant bacterial growth to identify factors that affect the prevalence of UTI. Age, sex, increased frequency, urgency, hematuria and/or abdominal discomfort (super-pubic pain), fever and chill, history of previous UTI, history of catheterization, and history of UTI for the last 3 years were found to be significantly associated with significant bacterial growth on binary logistic regression while age, sex, increased frequency, urgency, hematuria and/or abdominal discomfort (super-pubic pain), history of previous UTI and history of UTI for the last 3 years were found to be significantly associated with significant bacterial growth on multiple logistic regression (Table 1).

After adjusting for other variables, the age range of 40–59 was 77.7% less likely to have significant bacterial growth (AOR=0.223; 95% CI (0.071–0.704)). Correspondingly, females were 1.8 times more likely to have significant bacterial growth than males (AOR = 1.8; 95% CI (1.059–3.168)). Patients with no increased frequency of urination are 54.8% less likely to have significant bacterial growth. The odds of having a significant bacterial growth for patients with no urine urgency is four times compared to those with urine urgency (AOR=4.531; 95% CI (2.698–7.609)) (Table 1).

Regarding the presence of hematuria and/or abdominal discomfort, after adjusting for other variables, the odds of patients with no hematuria were 44.7% less likely to have a significant bacterial growth than patients with hematuria (AOR = 0.553; 95% CI (0.318–0.963)). Patients presented with no previous history of UTI were 97.3% less likely to have a significant bacterial growth compared to those with a previous history of UTI (AOR = 0.027; 95% CI (0.008–0.100)) and patients with no history of UTI for the last three years were 91.3% less likely to have a significant bacterial growth compared to patients with a history of UTI for the last three years (AOR = 0.087; 95% CI (0.013–0.562)) (Table 1).

The Prevalence and Distribution of Bacterial Isolates in Relation to Gender

The most predominant bacterial uropathogenic isolate was *Escherichia coli* which consisted of 78 (55.3%) of the total isolates followed by *Klebsiella pneumonia* 11 (7.8%). The subsequent isolates that were arranged according to isolation rate were Enterococcus faecalis 8 (5.7%), *Enterococcus faecium* and Providencia species 7 (5.0%), *Escherichia coli* (A-D) 6 (4.3%), Acinetobacter species, and *Pseudomonas specie* 5 (3.5%), *Pseudomonas aeruginosa* 4 (2.8%), *Klebsiella oxytoca* 3 (2.1%), *Staphylococcus aureus* 2 (1.4%). The least abundant bacterial isolates were Edwardsiella species, *Enterobacter cloacae*, *Morganella morganii*, *Proteus mirabilis*, and *Raoultella ornithinolytica*, each represented by one (0.7%) isolates. Moreover, most of the *E. coli* isolates 59 (75.6%) had been commonly infecting female participants (Table 2).

Table 2 The Prevalence and Distribution of Bacterial Isolates in Relation to Gender

	Sex				Total Significant Bacterial Growth Using Culture Media
	Female		Male		Significant Bacterial Growth
	Count	Row N %	Count	Row N %	Count
Gram Negative Bacterial Isolates	91	73.40%	33	26.60%	124
Acinetobacter species	2	40.00%	3	60.00%	5
Edwardsiella species	1	100.00%	0	0.00%	1
Enterobacter cloacae	0	0.00%	1	100.00%	1
Escherichia coli	59	75.60%	19	24.40%	78
Escherichia coli (A-D)	3	50.00%	3	50.00%	6
Klebsiella oxytoca	3	100.00%	0	0.00%	3
Klebsiella pneumonia	7	63.60%	4	36.40%	11
Morganella morganii	1	100.00%	0	0.00%	1
Proteus mirabilis	1	100.00%	0	0.00%	1

(*Continued*)

Table 2 (Continued).

	Sex				Total Significant Bacterial Growth Using Culture Media
	Female		Male		Significant Bacterial Growth
	Count	Row N %	Count	Row N %	Count
Providencia species	6	85.70%	1	14.30%	7
Pseudomonas aeruginosa	4	100.00%	0	0.00%	4
Pseudomonas species	3	60.00%	2	40.00%	5
Raoultella ornithinolytica	1	100.00%	0	0.00%	1
Gram Positive Bacterial Isolates	14	82.40%	3	17.60%	17
Enterococcus faecalis	5	62.50%	3	37.50%	8
Enterococcus faecium	7	100.00%	0	0.00%	7
Staphylococcus aureus	2	100.00%	0	0.00%	2
Total	105	74.50%	36	25.50%	141

Antimicrobial Susceptibility Pattern of the Isolates

Antimicrobial Susceptibility Pattern of Gram-Negative Bacteria Isolates

Amoxicillin had demonstrated the highest level of resistance from the overall resistance rate, which was (100%) for Gram-negative bacteria isolate while Cefazoline (71.3%) has shown a relatively lower level of resistance. At the species level, *E. coli*, the most frequently isolated bacterium, showed 100% resistance rates to Amoxicillin and Ampicillin-Sulbactam. The lowest level of resistance rate for *E. coli* was observed against Amikacin (2.2%). *K. pneumonia* showed a resistance rate of 100% against Amoxicillin, Ampicillin, Augmentin, and Ciprofloxacin, and the lowest level was observed against Amikacin (0.0%), Moxifloxacin (0.0%), and Levofloxacin (0.0%), respectively (Supplementary Table 1).

Antimicrobial Susceptibility Pattern of Gram-Positive Bacteria Isolates

A higher resistance rate in Tetracycline and Doxycycline having a value of 90.9% and 88.8% were observed, respectively. *Enterococcus faecalis* has shown a 100% resistance for Norfloxacine and Tetracycline and 83.3% resistance for Doxycycline, whereas it was 100% sensitive for Augmentin, Vancomycin, Levofloxacin, Moxifloxacin, and Gentamycin. On the other hand, *Enterococcus faecium* and *Staphylococcus aureus* were 100% resistant to Amoxicillin, Ampicillin, and Benzylpenicillin. *Staphylococcus aureus* was 100% sensitive to Agumentine, Cefazoline, Cephalotine, Cefuroxime, Cefotaxime, Ceftriaxone, and Methicillin. Generally, in this study, the multidrug resistance pattern of each AST drug that participated within two or more than two isolates was assessed and a higher MDR was observed 23/25 (92%) in gram-negative bacteria isolates and the least value of MDR was observed at 6/13 (46.2%) in GPB, to conclude that an average cumulative percentile of 29/38 (74.4%) had been observed in both groups (Supplementary Table 2).

Discussion

A total of 446 clinically suspected study participants for UTIs were enrolled, of which the prevalence rate of 141/446 (31.6%) urine samples was observed with significant bacterial growth in culture media. This finding has a slight agreement with a prevalence report from Uganda 32.2%,[17] South-Western Uganda 35%,[18] and India 45.32%.[19] However, our finding of UTI prevalence was higher when compared with a prevalence report from Libya 13.9%,[20] North India 17.0%,[21] and Ethiopia 15.9%, and 18.2%.[22,23] On the contrary, the prevalence rate of UTI obtained in this study was much less than another report from Ethiopia 90.1%[15] and India 65.5%.[24]

The largest number of cases in this study was found in the age group between 20 and 69 years, highest prevalence was found in young and early adult age group for the culture-positive study subjects, while the lowest was in the infant or baby age group of 0–2 years. Our finding was consistent with the report made in Midnapore Town, India.[25]

In this study, the highest prevalence of isolates was observed in the adult age group followed by the young which is also indicated in another study as described one episode of UTI can be observed in nearly 1 in 3 women and also the incidence of UTI increases with age goes-up estimated that 10% and 20% of men and women over the age of 65 years.[7,15] Age group (40–59), based on the grouped categories used in this study, showed a statistically significant relationship ($p < 0.05$) and significant possibility of protection from UTI cases as compared with age group of ≥80. This could be due to impaired status of immunity as the age goes up[17] similar with this study. In addition, this is often because of approximately 40–50% of the cases associated with asymptomatic bacteriuria both for men and women and misinterpreted as a UTI.

Gram-negative and gram-positive bacteria were accountable for UTI cases with a figure of 124 (87.9%) and 17 (12.1%), respectively, from the total of 141 bacteria isolated. The predominated isolates were gram-negative bacteria during this study and consistent findings were reported from Uganda, Libya, and three other studies from India.[18,20,21,24,25]

Among the type of bacterial isolates in this study, *E. coli* happens to be the most prevalent. The finding from Seifu WD and Gabissa AD has also shown a certain degree of agreement with the current study.[15] In addition, two studies conducted in Uganda and Ethiopia and two others from India have also shown a comparable report from this study.[15,17,21,22,25] Deviating from this study, a study conducted on the African continent in South-Western, Uganda[18] documented *Klebsiella pneumoniae* to be the foremost frequent isolate (37.41%). In addition, inconsistent with the current study, is a report showing *K. pneumoniae* to be recorded as the foremost frequent isolate in Asian nation, specifically in India by Madhya Pradesh.[24]

According to the overall finding of AST resistance profile from the isolated gram-negative bacteria, the highest level of resistance from the overall resistance rate was observed for Amoxicillin, which was (100%) followed by Ampicillin (98.9%), and Augmentin (92.1%). On the other hand, among the GNB isolates Acinetobacter species, *Escherichia coli*, *Klebsiella pneumonia*, Providencia species, *Escherichia coli* (A-D), *Pseudomonas aeruginosa*, *Pseudomonas species*, *Klebsiella oxytoca*, *Enterobacter cloacae* were not sensitive for more than ten antibiotics tested and all shown resistant including, *Morganella morganii* and *Proteus mirabilis* for both Ampicillin and Tetracycline with different resistance rate.

As described previously, the antimicrobial susceptibility profiles of gram-negative isolates that showed a lower resistance rate and good sensitivity were established through Amikacin, Moxifloxacin, Levofloxacin, and PTAZ that had been proven resistance rates. The pattern of AST in GNB isolates for Amikacin in the current study has similar findings to the report recorded in Libya.[20]

E. coli was the most predominant isolate from GNB that showed the highest resistance rates to Amoxicillin, Ampicillin-Sulbactam, Ampicillin, Augmentin, Tetracycline, and SXT consecutively which was in line with a study conducted in Uganda.[18] For *E. coli* isolates the most effective antibiotic observed in this study were Amikacin (97.8%) followed by moxifloxacin (94.4%), levofloxacin (78.9%), PTAZ (75%) and Gentamicin (74.1%); however, 100% resistance developed for Amoxicillin and 53.2% resistance for Nitrofurantoin which strongly contradicted with a study reported in India that has shown a sensitive finding for Nitrofurantoin (86.95%) followed by Amoxicillin (69.56%), Nalidixic acid (65.21%), and Cotrimoxazole (60.86%). On the other hand, Amoxicillin, Ampicillin-Sulbactam, Cefixime, Pefloxacin, and Ciprofloxacin showed similar susceptibilities of (63.63%) for *Klebsiella* isolates that disagree with the current study finding of *Klebsiella pneumoniae* 100% sensitive for Amikacin, Levofloxacin and Moxifloxacin and 80% sensitive for Tobramicin whereas 100% resistance for Amoxicillin, Ampicillin, Agumentine, Ciprofloxacin and Norfloxacine and also 90% resistance for tetracycline and Doxycycline.[19]

The AST profile of *Pseudomonas species* in this study was shown an extreme resistance (100%) against Nitrofurantoin which contradicts strongly with the study conducted in Asia, particularly in India.[26] In spite of the least abundant GNB isolate of Enterobacter cloacae showing 100% resistance to fifteen AST drugs, 100% sensitive for

Gentamycin, Tobramycin, and SXT were shown. On the other hand, Edwardsiella species, Morganella morganii, Proteus mirabilis, and *Raoultella ornithinolytica* were 100% resistant only for three different AST drugs and 100% sensitive for six, eight, nine, and ten AST drugs, respectively. A study conducted in India showed that a high susceptibility (100%) for Nitrofurantoin and Tetracycline was observed among the identified Proteus isolates.[19]

From the total antimicrobial susceptibility profile performed in gram-positive bacteria isolates, *Enterococcus faecalis* and *Staphylococcus aureus* together showed 100% resistance to Norfloxacine, but *Enterococcus faecium* was produced 80% sensitive to Norfloxacine. This study finding has deviated from a report conducted in India that considered Norfloxacine as effective with a susceptibility range of (66.6%) for *Staphylococcus aureus* isolates.[19]

Despite excluding AST pattern for both *Enterococcus faecium* and Enterococcus faecalis to Cefazoline, Cefotaxime, Ceftriaxone, Cefuroxime, Cephalothine, and Methicilline, exhibiting 100% sensitivity for *Staphylococcus aureus*. The current study described the profile of AST in *Staphylococcus aureus* for ceftriaxone and cefotaxime had been explained an identical finding with a report carried out by Mohammed Akram,[26] while excluding *Staphylococcus aureus* to evaluate the pattern of AST for *Enterococcus faecium* and *Enterococcus faecalis* had been established a sensitive value of 100% to Vancomycin, Levofloxacin, and Moxifloxacin, in spite of the variation in sensitive that had been clearly elaborated in case of Ciprofloxacin with a value of 80% and 66.7% for both respectively. As the pattern of AST for Enterococcus faecalis has proven that a different rate of resistance to Doxycycline (83.3%) and Tetracycline (85.7%), in spite of a similar rate of resistance 100% had been reported for each profile of AST in the case of *Enterococcus faecium* and additionally, the magnitude and severity of the current global challenge of antimicrobial resistance in GNB and GPB isolate become strongly supported by different study findings that had been carried out in many regions with explained similarly to the finding of this study as described the multidrug resistance (MDR) discovered in a given isolate had been 29 per 38 counts (74.4%).[15,22]

Conclusion

Our finding has shown a considerable contribution of gram-negative bacterial isolates, *Escherichia coli* being the substantial causes of urinary tract infections followed by *Klebsiella pneumonia*. In addition, a significant number of bacteriuria in female gender was observed. Most of the bacterial isolates have also demonstrated a pattern of multidrug resistance. Amikacin, Moxifloxacin, Levofloxacin, and PTAZ were the best antibiotic treatment against gram-negative bacteria isolates. Despite, the resistance was shown for Tetracycline, Doxycycline, Amoxicillin, and Ampicillin for GPB isolates, the best sensitivity performance was achieved in more than fourteen AST drugs in this study area.

Furthermore, history of catheterization, history of previous UTIs specifically history of UTIs in the last one year, and female gender were found to have statistically significant relationships with UTI, indicating that they could be possible risk factors associated with UTIs.

Recommendations

We recommend that considerable and due attention should be given to the impact of UTI in developing countries including Ethiopia which seemingly is challenged with emerging resistant strains for the ordinarily used antibiotic. This indicates for the critical need for appropriate antimicrobial administration and the practice of providing patients with suitable antibiotic relying on result obtained from the laboratory diagnosis of AST complying with local guidelines through considering the most often domestically isolated organisms.

Limitation of the Study

This study has a resource limitation and as a result all types of antibiotics were not used for the AST profiling.

Abbreviations

UTI, Urinary Tract Infection; AAML, Arsho Advanced Medical Laboratory; Department of Research and Ethical Review Committee (DRERC); CFU, Colony Forming Unit; AST, Antimicrobial Susceptibility Testing; Clinical and Laboratory Standards Institute (CLSI); AOR, Adjusted Odds Ratio; CI, Confidence Interval; MDR, Multi-Drug Resistance.

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