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Common Bacterial Pathogens and Their Antimicrobial Susceptibility Patterns In Patients with Symptomatic Urinary Tract Infections at Hiwot-Fana and Jugal Hospitals, Harar City, Eastern Ethiopia

IbssaIbrahim Abdulahi[1], Solomon Gebre-Selassie[2]

[1]Harari Regional Health Bureau,
[2]Addis Ababa University, School of Medicine, Ethiopia.

Corresponding Author: IbssaIbrahim Abdulahi

ABSTRACT

Background: Urinary tract infection (UTI) is one of the most common bacterial infections encountered by clinicians particularly in developing countries like Ethiopia. UTI is common in women and accounts for significant morbidity and health care costs. Escherichia coli are the primary urinary tract pathogen. The prevalence of antimicrobial resistance with UTI is increasing worldwide and varies according to geographical and regional location.
Objective: To determine the prevalence of *common bacterial uropathogens* and their antimicrobial susceptibility pattern *to commonly prescribed antibiotics and to* identify associated risk factors.
Methods: Across-sectional study was conducted during November 2010 to January 2011 among *348 consented* symptomatic UTI patients from both inpatient and outpatient departments of HiwotFana *and* Jugal Hospitals in Harar city. *Clean catch* mid-stream urine specimens were collected using sterile containers, cultured and processed following the standard bacteriological methods. Antimicrobial susceptibility test for isolated organisms was done as per the standard disk diffusion method. Patient information was obtained using designed questionnaire.
Results: From the total of 348 symptomatic UTI patients, significant bacteriuria was detected in 88(25.3%) of patients samples, and a total of 97 different bacterial uropathogens were isolated making the isolation rate to be 27.9%. Majority of the isolates, 77/97(79.4%) were Gram-negative organisms, while, *E. coli* was found to be the most frequent isolate (47/97, 48.5%), followed by *Klebsiella spp*. (15/97, 15.5%) and *S. aureus* 12/97 (12.4%). Significant bacteriuria was statistically associated with patient settings, previous history of hospitalization, diabetes and pregnancy. Overall multidrug resistance pattern was observed in 85.6% of the isolates. Only 4.1% of the isolates were sensitive to all antibiotics tested.
Conclusion: Single and multiple drug resistance to the commonly used antibiotics in the study area was found to be very high among the bacterial isolates leaving clinicians with a very few choices of drugs for the treatment of UTIs. Therefore, use of *antimicrobial* agents with in hospitals, public health care providers as well as private ones should be reviewed and further studies to explore the causes for increased resistance patterns and associated factors in the study area need to be carried out.

Key words: *Antimicrobial susceptibility test, Culture,* Significant bacteriuria, *Urinary tract infection, Uropathogens*

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections encountered by clinicians in developing countries. Although UTI seldom leads to complications, it can cause significant morbidity and mortality particularly when recurrent (Enenkel and Stille, 1988). It is estimated that 150 million cases of UTI occur on a global basis per year resulting in more than 6 billion dollars in direct health care expenditure (Guy's and St Thomas, 2004). Infections of the urinary tract are the second most common type of infection in humans. The variation of illnesses are quite wide ranging from asymptomatic bacteriuria to symptomatic urinary tract infections that spread to the blood causing complications such as shock and even death. Urosepsis accounts for up to 56% of sepsis in older adults, and mortality can be as high as 25% (Park, 2005). Urinary pathogens are among the most frequent causes of nosocomial infections seen in hospitals and vary depending upon age, sex, catheterization, hospitalization and previous exposure of antimicrobials (Gedebou *et al.,1987).* Most urinary tract infections are initiated by organisms that gain entrance from the natural environment to the bladder through the urethra and are more common in women than men (Volk *et al.,* 1996). Urinary tract infections (UTIs) affect millions of women each year and incur billions of dollars in treatment costs (Stapleton, 2002). It is estimated that 20% or more of the female population suffers some form of UTI in their lifetime and the morbidity in terms of quality of life and economic measures is tremendous. Each episode of UTI in a young woman results in an average of 6.1 days of symptoms, 1.2 days of decreased class/work attendance, and 0.4 days in bed (*Stapleton, 2002;* Stamm, 2004). Data from the tropics are less well documented. UTIs are detected in 2–8% of pregnant women. Bladder catheterization during or after delivery causes additional infections. Increased incidences of low birth weight, premature delivery, and neonatal death result from UTIs (particularly upper tract infections) during pregnancy (Stamm, 2004). Infection in the male population remains uncommon through the fifth decade of life, when enlargement of the prostate begins to interfere with emptying of the bladder. In the elderly of sexes, gynecologic or prostatic surgery, incontinence, instrumentation, and chronic urethral catheterization push UTI rates to 30 to 40% (Kenneth, 2004). Urinary tract infection is also a major problem in diabetics. The risk of developing infection in diabetic patients is higher and urinary tract is the most common site for infection (Nicolle, 2008).

UTI remains a major clinical problem over 50 years after the introduction of antimicrobial therapy. This is partly because of the emergence of increasing rate of drug resistance in UTI. The prevalence of antimicrobial resistance with UTI is increasing and has been reported from various countries (Stamm and Norrby, *2001)* including Ethiopia, Addis Ababa (Wolday and Worku, 1997), and Gondar (Moges *et al.*, 2002). The emergences of resistant bacterial strains in hospitals pose a continued challenge to treat and control the spread of infections. This is further complicated by the fact that in most hospitals routine culture and sensitivity testing is not done and treatment is only on empirical basis (Dennesen et al., 1998). To our knowledge, no microbiological data exist on predominant bacterial isolates *and* their antimicrobial susceptibility patterns from urinary tract infections in Harari region in general and in the study area in particular (personal communication). Since the increasing prevalence of antimicrobial resistance with urinary tract infection varies according to geographical and regional location (Khan and Zaman, 2006), and the management of symptomatic UTI patients is largely based on empiric treatment in most regions in Ethiopia, up to date information is essential for clinicians for appropriate antimicrobial therapy.Therefore, this study was undertaken to address the current magnitude of locally predominant bacterial isolates of UTI and associated risk factors and to determine their antimicrobial susceptibility patterns to most commonly used antibiotics among *symptomatic UTI* patients attending at HiwotFana and Jugal Hospitals.

MATERIALS AND METHODS

Study area

Harar is an eastern city of Ethiopia. The study was carried out at both inpatient and outpatient departments where symptomatic UTI patients are seen in HiwotFana and Jugal Hospitals in the city. The Hospitals are not only providing service to the People in the region but also serving as referral centers to neighbouring regions like Somali region and to the Eastern

Oromia. Besides, the Hospitals are serving as a teaching facility for different Governmental and Private colleges and currently HiwotFana Hospital is on the way to be University Hospital after Haramaya University is authorized to control it.

Study design and period

Across-sectional prospective study design was conducted during the study period from November 2010 to January 2011 in the study area.

Study subjects

Informed and consented symptomatic UTI patients with age range between 18-75 years from both inpatient and outpatient departments *(n=348)* of HiwotFana and Jugal Hospitals were investigated for UTIs.

Inclusion criteria

All symptomatic UTI patients whose age was ≥18 years old and willing to participate in the study were included.

Exclusion criteria

Symptomatic UTI patients who are on antibiotic treatment for any disease for the last two weeks and whose age was less than eighteen years old were excluded *from the study*.

A symptom of UTI is defined as the presence of at least two of the following complaints: - dysuria, urgency, frequency, incontinence, suprapubic pain, flank pain or cost vertebral angle tenderness, fever (temperature of 38^{o}C) and chills.

All *symptomatic UTI* patients *who visit the two hospitals* during the study period were interviewed using pre-tested questionnaire that includes socio-demographic, risk factor and clinical data by attending physicians and transferred to a questionnaire prepared for this study.

Sample size was calculated by considering a 95% confidence, 29.0% prevalence based *on the prevalence indicated in Gondar University Teaching Hospital (*Tessema *et al*., 2007*)*, 5% margin of error and 10% contingency. A total of 348 *symptomatic UTI* patients attending both Hospitals during the study period were included in this study.

Collection, handling and transport of specimens

Each s*ymptomatic UTI* patient was informed about how to collect a 'clean-catch' midstream urine specimen by the attending physicians. They were told first to clean their hands with water and soap, and then cleanse the periurethral area with sterile cotton-swab soaked in normal saline. Accordingly, about 10 to 20 ml urine specimen was collected in a sterile screw-capped, wide-mouth container from each s*ymptomatic UTI* patient. The bottles were labelled with unique sample number, date and time of collection; then immediately delivered to bacteriology department of Regional laboratory within one hour after collection where urine samples were processed. The specimens that were not examined within one hours of collection were refrigerated at 4^{o}C until processed. Urine specimens that were not processed within 2 hours after collection were discarded.

Culture and identification of Bacteria:

Well mixed and uncentrifuged urine samples were inoculated onto 5% Blood Agar and MacConkey agar plates (Oxoid Ltd, Basingstoke, and Hampshire, England) by streak plate methods following the Standard Microbiological techniques and procedures developed by Finegold and Martin (Baron and Finegold, 1994*)* and (Cheesbrough, 2006) to obtain pure and well isolated colonies that can simplify counting of colonies after growth using a calibrated loop that deliver 0.001 ml of urine specimen. After incubating the plates aerobically at *37°C* for 24 hours, they were inspected for the presence or absence of the bacterial growth and colonies were counted and checked for significant bacteriuria on Blood Agar. Urine cultures which grew $\geq 10^{5}$ colony-forming units /ml of single colony each were considered as significant bateriuria. For mixed cultures growing more than one bacteria subculturing of individual distinct colonies were done using a sterile wire loop to transfer a portion of isolated colony on the surface of blood Agar to ensure pure cultures were obtained for subsequent procedures used to identify bacteria.

All positive urine cultures showing significant bacteriuria were further identified by their physical characteristics such as colony morphology, odor, swarming and presence of hemolysis on their respective media and confirmed by the pattern of biochemical reactions using the standard procedures (*Baron and Finegold, 1994; Cheesbrough, 2006*). Thus Gram-negative rods were identified with the help of a series of biochemical tests such as Triple sugar iron agar, Indole, Simmons Citrate agar, lysine decarbooxylase, Urease and motility *(*Cheesbrough, 2006*)*. That ismorphologically identical colonies of the suspected strains were taken from the agar plates and suspended in nutrient broth and vortexed. Then the suspensions were inoculated to the butt and slant of the biochemical testing media. The inoculated media were incubated aerobically at *37 °C* and *after overnight* incubation bacteria were identified following the standard flow chart. Gram-positive cocci were identified based on their Gram reaction, catalase and coagulase tests (*Baron and Finegold, 1994; Cheesbrough, 2006*). Each culture medium was prepared as per the instruction of the manufacturer (Oxoid Ltd, Basingstoke, Hampshire, England).

Antimicrobial susceptibility testing

Antimicrobial susceptibility testing was performed for 97 bacterial uropathogens isolated from urine cultures with significant bacteriuria using Kirby-Bauer disk diffusion method *on Mueller-Hinton agar* (Oxoid Ltd, Basingstoke, and Hampshire, England) according to the criteria set by the Clinical and Laboratory Standards Institute formerly known as National Committee for Clinical Laboratory Standards (NCCLS, 2002; CLSI, 2005) to determine susceptibility patterns to commonly used antibiotics. The antimicrobials for disc diffusion testing were obtained from Oxoid in the following concentrations: ampicillin (AMP) (10µg), ceftriaxone (CRO) (30 µg), chloramphenicol (C) (30µg), ciprofloxacin (CIP) (5µg), erythromycin (E) (15µg), gentamicin (GEN) (10µg), nalidixic-acid (NA) (30µg), penicillin (P) (10IU), trimethoprim-sulfamethoxazole (SXT) (25µg) and Tetracycline (TTC) (30µg). Among these, nalidixic-acid was only used for Gram-negative bacteria while erythromycin and penicillin were used only for Gram-positive bacteria however; the rest antimicrobials were used for both isolates.

Briefly four to six morphologically identical colonies of bacteria from pure culture were picked with an inoculating loop and transferred into a tube containing 5ml nutrient broth and mixed gently until a homogenous suspension was formed and incubated at 37^{o}C for 3-5 hours until the turbidity of the suspension becomes adjusted to the density of 0.5 McFarland standards, which yield a uniform suspension containing 10^{5}-10^{6} cells/ml. Using a sterile non-toxic dry cotton swab, the standardized inoculum (turbidity so adjusted to obtain confluent growth) was streaked on the entire surface of the dried Mueller-Hinton agar plate three times, turning the plate at 60º angle between each streaking to ensure even distribution. The inoculums were allowed to dry for 5-15 minutes with lid in place.

Using a sterile forceps the selected antibiotics discs were applied onto the plates at a distance of 15 mm away from the edge and 24 mm apart from each other. After incubating the plates at 37^{o}C for 24 hours, diameters of the zone of bacterial growth inhibition around the discs were measured to the nearest millimeter and the susceptibility or resistance to the agent in each disc was determined and the isolates were classified as sensitive, intermediate or resistant according to the standardized table provided by the manufacturer (NCCLS, 2002; CLSI, 2005). As the number of intermediate susceptibility reading was very small all were considered as sensitive.

Quality control

Standard Operating Procedures (SOPs) were followed during laboratory analysis.

Reference strains of E. coli (ATCC-25922), S. aureus (ATCC-25923) and P. aeruginosa (ATCC-27853), were used as a quality control throughout the study for culture and antimicrobial susceptibility testing. All the standard strains were obtained from the Ethiopian Health and Nutrition Research Institute (EHNRI).

Data analysis

The data obtained from this study were analyzed using statistical package for social science (SPSS, version 16). Percentage for proportion, and odds ratio for categorical variable were used wherever appropriate. A p-value < 0.05 were considered as statistically significant.

Ethical considerations

The research project proposal was approved and ethically cleared by the Research and Ethical Review Committee of *the Department of Microbiology, Immunology and Parasitology*, School of Medicine; Addis Ababa University. Official permission from the study site was obtained both from *Harari Regional State Health Bureau and Haramaya University*.

All s*ymptomatic UTI* patients *who visit the two hospitals* during the study period were informed about the purpose of the study and their consent were sought for the study. Any information related with the patient and clinical history was kept confidentially. All positive cases were reported to the attending physicians who treated them according to the results.

RESULTS

Study subjects

A total of 348 symptomatic UTI patients were included in the study from both HiwotFana and Jugal Hospitals. Of the 348 symptomatic UTI patients investigated, 176(50.6%) were from HiwotFana Hospital and the remaining 172(49.4%) were from Jugal Hospital. Out-patients and In-patients represent 298(85.6%) and 50(14.4%) of the patients, respectively from both Hospitals. Female patients constituted 211 (60.6%) while males were 137 (39.4%) of the patients, resulting in male to female ratio of 0.6:1. Most of them 276(79.3%) were from urban part of Harar and surrounding Regions, where as 72 (20.7%) of the patients were from rural part of *Harari as well as* the surrounding *Regions*. The mean age of the study participants was 34.0 years with age range between 18 years to 75 years. Majority of them, 115 (33.0%) were in the age range of 25-34 years while only 8(2.3%) were in the age group 65 years and above (Table 1).

Table 1. Socio-demographic characteristics of symptomatic UTI patients attending at HiwotFana and Jugal Hospitals

Characteristic	**Total (n=348)**	
	Frequency (No)	**Percent (%)**
Sex		
Male	137	39.4
Female	211	60.6
Age		
18-24	89	25.6
25-34	115	33.0
35-44	61	17.5
45-54	51	14.7
55-64	24	6.9
≥ 65	8	2.3
Address		
Urban	276	79.3
Rural	72	20.7
Patient settings		
Outpatient	298	85.6
In-patient	50	14.4
History of UTI		
Yes	84	24.1
No	264	75.9
History of Hospitalization		
Yes	38	10.9
No	310	89.1
History of antibiotics use for UTI		
Yes	84	24.1
No	264	75.9
History of catheterization		
Yes	34	9.8
No	314	90.2

Uropathogen bacterial species

A total of 97 different bacterial uropathogens were isolated from 348 symptomatic UTI patients investigated for UTIs. Majority of the isolates (77/97, 79.4 %) were Gram-negative organisms, while only 20.6 % (20/97) were Gram-positives. Out of the 97 bacterial isolates, *E .coli* was found to be the most frequent isolate (47/97, 48.5 %), followed by *Klebsiella spp* (15/97, 15.5 %), *S. aureus* (12/97, 12.4 %), and *Proteus spp* (10/97, 10.3 %). Others found in relatively small numbers include, *Coagulase negative Staphylococci (CONS*), *Pseudomonas aeruginosa* and *Citrobacter species*. *E.coli*, *Pseudomonas aeruginosa*, and *CONS* were more common among females, *while Klebsiella spp.* And *Proteus spp*. occurred more frequentlyamong male patients (*Table* 3.2.a.).

P. aeruginosa and *S. aureus*were more commonly isolated from in-patients while *E .coli*, *CONS andCitrobacter species* were more commonly isolated from out-patients. However, in the present study the distribution of Klebsiella *spp. and Proteus spp.* were almost the same among both out-patients (Table 2).

More than one type of organisms were observed in 9/348 (2.6 %) of urine specimens cultured from symptomatic UTI patients. Of these, 1/9(11.1%) was from out-patients and 8/9 (88.9 %) were isolated from in-patients. *E. coli* with other Gram-negative and Gram-positive bacteria was most commonly identified in cultures with multiple species (Table 2).

Table 2. Frequency and types of bacterial species isolated from urine culture of symptomatic UTI patients attending at HiwotFana and Jugal Hospitals

Types of bacterial species	Total No (%)	Sex		Patient settings	
		Male No (%)	Female No (%)	Out-patients No (%)	In-patients No (%)
E. coli	47(48.5)	14(45.2)	33(50.0)	36(57.1)	11(32.4)
Klebsiellaspp	15(15.5)	7(22.6)	8(12.1)	10(15.9)	5(14.7)
Proteus spp	10(10.3)	6(19.4)	4(6.1)	6(9.5)	4(11.8)
P. aeruginosa	3(3.1)	0(0)	3(4.5)	0(0)	3(8.8)
Citrobacterspp	2(2.1)	1(3.2)	1(1.5)	2(3.2)	0(0)
S. aureus	12(12.4)	3(9.7)	9(13.6)	3(4.8)	9(26.5)
Coagulase negative Staphylococcus	8(8.2)	0(0)	8(12.1)	6(9.5)	2(5.9)
Total	97(100.0)	31(32.0)	66(68.0)	63(65.0)	34(35.0)

Table 3.Multipleinfections among symptomatic UTI patients attending at HiwotFana and Jugal Hospitals.

Pattern of multiple infection	Total No. (%)	Patient settings	
		Out-patients No. (%)	In-patients No. (%)
E. coli and Klebsiella spp.	1(11.1)	1(100.0)	-
E. coli and Proteus spp.	2(22.2)	-	2(25.0)
E. coli and P. aeruginosa	1(11.1)	-	(12.5)
E. coli and S. aureus	3(33.3)	-	3(37.5)
E. coli and CONS	2(22.2)	-	2(25.0)
Total	9(100.0)	1(11.1)	8(88.9)
CONS= *Coagulase negative Staphylococci*			

Prevalence of Urinary Tract Infection and Risk Factors associated with UTI

Of the total 348 urine specimens processed 260 (74.7%) showed no significant bacteriurial growth. Significant bacteriuria was detected in 88 (25.3%) of samples, and in 9 (2.6%) of the urine samples two bacteria each were isolated making the number of bacteria isolated to be 97 with the isolation rate of 27.9% (Table 3.2a). Significant bacteriuria was more common in females, 59/211 (28.0%) than males, 29/137 (21.2) (P=0.155) and more observed in symptomatic UTI patients with age 65 and above 3/8 (37.5%) (P=0.480) (Table 3.3). Significant bacteriuria was more common among in-patients, 26/50 (52.0%) than out-patients, 62/298 (20.8%) (P=0.000) (Table 3.3). Significant bacteriuria was also more common in symptomatic UTI patients with the previous history of UTI and previous antibiotic treatment 37/84 (44.0%) than in those with no previous history of UTI and antibiotic treatment 51/264 (19.3%) (P=0.000), in patients with the previous history of hospitalization 23/38 (60.5%) and in patients with previous use of catheterization 20/34 (58.8%) than in those with no previous history of hospitalization 65/310 (21.0%) and in patients with no previous use of catheterization 68/314(21.7%) respectively, (P=0.000) (Table 3.3). However, Significant bacteriuria was statistically associated with patient settings (P=0.016), previous history of hospitalization (P=0.036), diabetes (P=0.05) and pregnancy (P=0.019) (Table 3.3).

No statistically significant differences were observed in the isolation frequency of each bacterial uropathogens amongout-patients and in-patients (P=0.137) except for *S. aureus* (P=0.002).

Table.3.3: Variables associated with significant bacteriuria in symptomatic UTI patients attending at HiwotFana and Jugal Hospitals

Characteristics	Total UTI No (%)	Crude-OR (95.0% CI)	Adjusted-OR (95.0% CI)	P value
Sex				
Male	29 (33.0)	1	1	
Female	59 (67.0)	1.446 (0.869-2.403)	1.263 (0.707-2.254)	0.430
Patient-settings				
Out-patient	62 (70.5)	1	1	
In-patient	26 (29.5)	4.124 (2.215-7.676)	2.637 (1.200-5.797)	0.016
History of UTI				
No	51 (58.0)	1	1	
Yes	37 (42.0)	3.288 (1.939-5.575)	2.224 (0.981-5.042)	0.056
History of hospitalization				
No				
Yes	65 (73.9)	1	1	
	23 (26.1)	5.779 (2.854-11.704)	2.770 (1.069-7.174)	0.036
History of catheterization				
No				
Yes	68 (77.3)	1	1	
	20 (22.7)	5.168 (2.481 - 10.766)	1.416 (0.488- 4.107)	0.522
Underlying condition				
No				
UT anatomical defect	28 (31.8)	1	1	
Diabetes	4 (4.5)	10.643(1.859-60.923)	3.023 (0.386-23.649)	0.292
Kidney stone	15 (17.0)	2.752 (1.310-5.784)	2.197 (1.002-4.821)	0.050
Pregnancy	8 (9.1)	3.041 (1.167-7.925)	1.536 (0.507-4.654)	0.448
Menopause	17 (19.3)	2.320 (1.154-4.663)	2.340 (1.151-4.755)	0.019
Enlarged prostate	2 (2.3)	1.520 (0.300-7.702)	0.747 (0.105-5.293)	0.770
More than one	3 (3.4)	2.661 (0.628-11.269)	0.765 (0.116-5.054)	0.781
condition	11(12.5)	4.181 (1.722-10.150)	0.470 (0.115-1.910)	0.291

OR: odds ratio, CI: confidence interval

Antimicrobial susceptibility

Gram negative bacteria

The result of antimicrobial susceptibility testing for Gram-negative bacteria (n=77) isolated from urine culture of symptomatic UTI patients against chosen antimicrobial agents is presented in Table 3.4a. Gram-negative isolates showed a high level (>80%) of susceptibility to ciprofloxacin, ceftriaxone and nalidixic acid. Intermediate level of resistance (60-80%) was observed against trimethoprim-sulfamethoxazole. Low level of resistance (<60%) was observed against ciprofloxacin, ceftriaxone, gentamicin, nalidixic acid and chloramphenicol, but showed high level of resistance (>80%) against ampicillin and tetracycline. Among Gram-negative bacteria, though the number of isolates was low, extremely high resistance patterns were observed in the three isolates of *P. aeruginosa* for ampicillin (100%), chloramphenicol (100%), trimethoprim-sulfamethoxazole (100%), tetracycline (100%), ceftriaxone (66.7%), gentamicin (66.7%) and nalidixic acid (66.7%). The second high rates of drug resistance values were found in *Klebsiella species*forampicillin (100%), tetracycline (100%), chloramphenicol (86.7%), trimethoprim-sulfamethoxazole (86.7%) and gentamicin (60.0%) (Table 3.4a).

Gram positive bacteria:

The result of antimicrobial susceptibility testing for Gram-positive bacteria (n=20) isolated from urine culture of symptomatic UTI patients against chosen antimicrobial agents is presented in Table 3.4b. Gram-positive isolates showed a high level (>80%) of susceptibility to gentamicin. They showed Intermediate level of resistance (60-80%) to chloramphenicol, penicillin and tetracycline while showed low level of resistance (<60%) to the rest of antimicrobials tested (ampicillin, Ceftriaxone, ciprofloxacin, trimethoprim-sulfamethoxazole, erythromycin and gentamicin). Of the Gram-positive isolates, *S. aureus* showed high level of drug resistance for tetracycline (>83.3%), penicillin (75%), chloramphenicol (66.7%), trimethoprim-sulfamethoxazole (58.3%) and ampicillin (50%).

It was also noticed in the present study that the pathogens causing UTI among study subjects in community and hospital set up showed almost the same percentage of resistance except for observation of more resistance patterns among in-patients for ciprofloxacin and chloramphenicol.

Among all bacterial isolates (both Gram-negative and Gram-positive) a high level (>80%) of susceptibility was observed in ceftriaxone and ciprofloxacin, while a high level of resistance (>80%) was observed against tetracycline (Table 3.4a and Table 3.4b).

Table 3.4a. Antimicrobial susceptibility pattern of Gram-negative bacteria isolated from urine culture of symptomatic UTI patients attending at HiwotFana and Jugal Hospitals, Harar, Ethiopia (Nov 2010-Jan 2011).

Bacteria isolated	Total N(%)	S/R	Antimicrobial agents tested							
			AMP N (%)	CRO N (%)	CAF N (%)	CIP N (%)	GEN N(%)	NA N (%)	SXT N (%)	TTC N (%)
E. coli	47(61.0)	S	8(17.0)	44(93.6)	28(59.6)	44(93.6)	39(83.0)	43(91.5)	22(46.8)	9(19.1)
		R	39(83.0)	3(6.4)	19(40.4)	3(6.4)	8(17.0)	4(8.5)	25(53.2)	38(80.9)
		S	-	8(53.3)	2(13.3)	13(86.7)	6(40.0)	10(66.7)	2(13.3)	-
Klebsiella spp	15(19.5)	R	15(100)	7(46.7)	13(86.7)	2(13.3)	9(60.0)	5(33.3)	13(86.7)	15(100)
Proteus spp	10(13.0)	S	2(20.0)	8(80.0)	3(30,0)	9(90.0)	7(70.0)	8(80.0)	2(20.0)	-10(100)
		R	8(80.0)	2(20.0)	7(70.0)	1(10.0)	3(30.0)	2(20.0)	8(80.0)	
Pseudomonas aeruginosa	3(3.9)	S	-	1(33.3)	-	2(66.7)	1(33.3)	1(33.3)	-	-
		R	3(100)	2(66.7)	3(100.0)	1(33.3)	2(66.7)	2(66.7)	3(100.0)	3(100.0)
Citrobacter spp	2(2.6)	S	-	1(50.0)	-	2(100.0)	1(50.0)	2(100)	-	-
		R	2(100)	1(50.0)	2(100)	-	1(50.0)	-	2(100)	2(100)
Total	77(100)	S	10(13.0)	62(80.5)	33(42.9)	70(90.9)	54(70.1)	64(83.1)	26(33.8)	9(11.7)
		R	67(87.0)	15(19.5)	44(57.1)	7(9.1)	23(29.9)	13(16.9)	51(66.2)	68(88.3)

S/R=Sensitive/Resistant; AMP = Ampicillin; CRO=Ceftriaxone;
CAF=Chloramphenicol; CIP=Ciprofloxacin; GEN= Gentamicin;
NA=Nalidixic-acid; SXT=trimethoprim-sulfamethoxazole; TTC= Tetracycline

Table 3.4b. Antimicrobial susceptibility pattern of Gram-positive bacteria isolated from urine culture of symptomatic UTI patients attending at HiwotFana and Jugal Hospitals.

Bacterial isolate	Total No (%)	S/R	Antimicrobial agents tested								
			AMP No(%)	CRO No(%)	CAF No(%)	CIP No(%)	ERY No(%)	GEN No(%)	P No(%)	SXT No(%)	TTC No(%)
S.aureus	12(60.0)	S	6(50.0)	8(66.7)	4(33.3)	8(66.7)	9(75.0)	10(83.3)	3(25.0)	5(41.7)	2(16.7)
		R	6(50.0)	4(33.3)	8(66.7)	4(33.3)	3(25.0)	2(16.7)	9(75.0)	7(58.3)	10(83.3)
CONS	8(40.0)	S	6(75.0)	8(100.0)	4(50.0)	7(87.5)	6(75.0)	7(87.5)	4(50.0)	4(50.0)	5(62.5)
		R	2(25.0)	--	4(50.0)	1(12.5)	2(25.0)	1(12.5)	4(50.0)	4(50.0)	3(37.5)
Total	20(100.0)	S	12(60.0)	16(80.0)	8(40.0)	15(75.0)	15(75.0)	17(85.0)	7(35.0)	9(45.0)	7(35.0)
		R	8(40.0)	4(20.0)	12(60.0)	5(25.0)	5(25.0)	3(15.0)	13(65.0)	11(55.0)	13(65.0)

S/R=Sensitive/Resistant; CONS= Coagulase negative Staphylococci;
AMP=Ampicillin; CRO=Ceftriaxone; CAF=Chloramphenicol;
CIP=Ciprofloxacin; ERY= Erythromycin; GEN=Gentamicin; P=Penicillin;
SXT=trimethoprim-sulfamethoxazole; TTC= Tetracycline

Multi-drug resistance

Multidrug resistance to two or more drugs was observed in 67/77 (87.0 %) of Gram-negative isolates (Table 3.4c) and in 16/20 (80.0 %) of Gram-positive bacteria isolates (Table 3.4d).

Multidrug resistance was generally accounted for 83/97 (85.6 %) for both groups (Gram-negative and Gram-positive), while 4.1 % were found to be sensitive to all antibiotics tested and 10.3 % were resistant to only one antibiotic.

Four bacterial isolates 4/97 (4.1 %), each from *Klebsiella spp*., *Proteus spp*.,*P. aeruginosa and S. aureus were* resistant to all antibiotics tested.

Table 3.4c. Multi-drug resistance pattern of Gram-negative bacteria isolated from urine culture of symptomatic UTI patients attending at HiwotFana and Jugal Hospitals

Combination of Antibiotics	Total	*E. coli*	*Klebsiella*spp	*Proteus spp.*	*P. aeruginosa*	*Citrobacter*spp
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
AMP, SXT	1(1.5)	1(2.6)	--	-	-	-
AMP, TTC	8(11.9)	7(18.4)	1(6.7)	-	-	-
SXT, TTC	1(1.5)	-	-	-	-	-
AMP, CAF , TTC	3(4.5)	2(5.3)	-	1(11.1)	-	-
AMP, SXT, TTC	9(13.4)	9(23.7)	-	-	-	-
AMP, SXT , NA	1(1.5)	1(2.6)	-	-	-	-
AM , GEN , TTC	2(3.0)	1(2.6)	1(6.7)	-	-	-
CAF, SXT , TTC	1(1.5)	1(2.6)	-	-	-	-
AMP,CAF, SXT, TTC	12(17.9)	6(15.8)	2(13.3)	4(44.4)	-	-
AMP, CAF, GEN, TTC	2(3.0)	2(5.3)	-	-	-	-
AMP, GEN, SXT, TTC	2(3.0)	2(5.3)	-	-	-	-
AMP, CRO, CAF, SXT, TTC	3(4.5)	1(2.6)	1(6.7)	-	-	1(50.0)
AMP, CAF, CIP, SXT, TTC	1(1.5)	1(2.6)	-	-	-	-
AMP, CAF , NA , SXT , TTC	2(3.0)	-	1(6.7)	-	1(33.3)	-
AMP, CAF, GEN, SXT, TTC	5(7.5)	2(5.3)	2(13.3)	-	-	1(50.0)
AMP, CRO, CAF, GEN,SXT, TTC	5(7.5)	1(2.6)	3(20.0)	-	1(33.3)	-
AMP, CRO, CAF, CIP, NA, TTC	1(1.5)	1(2.6)	-	-	-	-
AMP,CRO,CAF,NA , SXT , TTC	1(1.5)	-	1(6.7)	-	-	-
AMP,CRO,CAF,GEN,NA,SXT,TTC	2(3.0)	-	1(6.7)	1(11.1)	-	-
AMP,CAF,CIP,GEN,NA, SXT , TTC	2(3.0)	1(2.6)	1(6.7)	-	-	-
AMP, CRO, CAF, CIP, GEN, NA , SXT, TTC	3(4.5)	-	1(6.7)	1(11.1)	1(33.3)	-
TOTAL	67(100.0)	38(100.0)	15(100.0)	9(100.0)	3(100.0)	2(100.0)

AMP=Ampicillin; CRO=Ceftriaxone; CAF=Chloramphenicol; CIP=Ciprofloxacin GEN= Gentamicin; NA=Nalidixic-acid; SXT=trimethoprim-sulfamethoxazole; TTC= Tetracycline

Table 3.4d. Multi-drug resistance pattern of Gram-positive bacteria isolated from urine culture of symptomatic UTI patients attending at

Combination of Antibiotics	Total No. (%)	*S. aureus* No. (%)	*CONS* No. (%)
AMP, P	1(6.3)	1(8.3)	-
AMP , TTC	1(6.3)	1(8.3)	-
AMP, P, TTC	1(6.3)	1(8.3)	-
P, SXT ,TTC	2(12.5)	1(8.3)	1(25.0)
CRO, CAF, TTC	1(6.3)	1(8.3)	-
CAF, SXT, TTC	1(6.3)	1(8.3)	-
AMP, CAF, P, TTC	2(12.5)	1(8.3)	1(25.0)
AMP, CAF, ERY, P, SXT	2(12.5)	1(8.3)	1(25.0)
CRO, CAF, CIP, P, SXT, TTC	2(12.5)	2(16.7)	-
CAF, CIP, ERY, GEN, P, SXT, TTC	2(12.5)	1(8.3)	1(25.0)
AMP, CRO, CAF, CIP, ERY, GEN, P, SXT, TTC	1(6.3)	1(8.3)	-
TOTAL	16(100.0)	12(100.0)	4(100.0)

HiwotFana and Jugal Hospitals, Harar, Ethiopia (Nov 2010-Jan 2011).

CONS= Coagulase negative Staphylococci AMP=Ampicillin; CRO=Ceftriaxone; CAF=Chloramphenicol; CIP=Ciprofloxacin ERY= Erythromycin; GEN= Gentamicin; P= Penicillin SXT=trimethoprim-sulfamethoxazole; TTC= Tetracycline

DISCUSSION

Urinary tract infections (UTIs) represent one of the most common diseases encountered in medical practice today, accounting for nearly seven million office visits and one million emergency department visits each year in the United States resulting in 100,000 hospitalizations of women, the elderly and patients with spinal cord injuries and/or catheters, diabetes, multiple sclerosis and also HIV (Foxman, 2003). However, its impact and frequency vary in different populations. It is estimated that about 20–30 % of adult women experience UTI at least once during their life. UTIs occur at a rate of 2–3 per 100 hospital admissions and constitute 35–40% of all hospital-acquired infections (Kunin, 1994; Barnett and Stephens, 1997; Foxman, 2003).

The successful management of patients suffering from bacterial UTIs depends upon the identification of the types of organisms that cause the disease and the selection of an effective antibiotic against the organism in question (Harding and Ronald, 1994). The emergences of resistant bacterial strains in hospitals pose a continued challenge to treat and control the spread of infections. Moreover, the indiscriminate use of antibiotics often results in the increased resistance of urine pathogens to most commonly used antimicrobial drugs (Alanis, 2005). There are no organized surveillances of microbial isolates, associated risk factors and drug resistance among common microbial isolates in Ethiopian patients and even no studies done in Harari Regional State. Furthermore, due to the changing susceptibility pattern of many urine pathogens, it is necessary to perform surveillance from time to time in order to alert clinicians to local drug susceptibility patterns. In addition, there is no routine culture for identification of the etiologic agents and their drug sensitivity testing in several hospitals. Thus the data presented in this study could provide information of immediate public health importance to clinicians on the selection of antimicrobial drugs for the treatment of patients suffering from urinary tract infections.

In the present study a total of 348 symptomatic UTI patients were investigated for UTI. Of these, 298 (85.6 %) were out-patients and the remaining 50 (14.4 %) of the patients were in-patients (Table 3.1). The mean age of the study participants was 34.0 years (age range 18-75 years). Majority of them (33.0 %) were in the age range of 25-34 years.

In this study, the overall prevalence of significant bacteriuria in the study subjects was 25.3%. Similar findings have been reported in Ethiopia and India, with overall prevalence in catheterized and non-catheterized UTIs from Jimma (27%) (Teshager *et al.*, 2008), in pregnant women with symptomatic UTI from Addis Ababa, (20 %) (Assefa *et al.*, 2008), India, Kashmir (25.3%) (Manzoor *et al.*, 2005), however a relatively lower prevalence of bacteriuria has been reported from Addis Ababa (14%) (Feleke *et al.*, 2007) and in Kuwait (11.4%) (Dimitrov *et al.*, 2004).

In the present study, the isolation rate of bacteria from urine was 27.9%. This is in accordance with other previous studies from Gondar (29.1%) (Tessema *et al.*, 2007), Addis Ababa (30%) (Wolday and Erge, 1997) and Bahir Dar (30.2%) (Biadglegne and Abera, 2009). However, it is lower than other previous reports from Gondar where a 39.5% (Moges *et al.*, 2002) and 36.6% (*Abraham and Girmay, 1996*) isolation rate was reported. The higher prevalence of UTI in females than in males where 67.0% of female patients harbored greater proportion of bacterial etiologic agents of UTI in this study is also in agreement with the findings of other study, from Gondar (63.2%) (Moges *et al.*, 2002), and (61.3%) (Tessema *et al.*, 2007) and as suggested by Willet and Radojcic, this could be due to their shorter and wider urethra as well as its proximity to the anus, predisposing for ascending infection by organisms colonizing the peri-anal area (Willet and Radovic,1976).

The results of this study also showed that the etiologic agents of UTIs mainly belonged to Gram- negative enteric bacteria (79.4%), which is consistent with previous studies conducted in Ethiopia, 83.3% (Tessema *et al.*, 2007), 72.5% (Biadglegne and Abera, 2009), 71.5% (Moges*et al.*, 2002); and also Similar with findings elsewhere in Africa (Idowu and Odelola, 2007; Theodore, 2007).

The result also indicate that, *E. coli* was found to be the most frequent isolate (48.5%), which is similarly reported from the different areas of the country (Tessema *et al.*, 2007; Biadglegne and Abera, 2009; Moges *et al.*, 2002; Assefa*et al.*, 2008). The second most common isolate was *Klebsiella* species (15.5%) which agrees with other reports that indicate *Klebsiella Spp.*are the commonest pathogens isolated next to *E. coli* in patient with urinary tract infections (Wolday and Erge, 1997; Gedebou, 1983; Idowu and Odelola, 2007; Theodore, 2007), but it is higher than what has been reported in previous studies conducted in Ethiopia (Moges *et al.*, 2002; Tessema *et al.*, 2007; Biadglegne and Abera, 2009; Assefa *et al.*, 2008).

The isolation rate of *S. Aureus* (12.4%) is in line with other reports

(Tessema *et al*., 2007; Theodore, 2007), but it is higher than that reported from Gondar and Addis Ababa (*Abraham and Girmay, 1996;* Wolday and Erge, 1997), and from Nigeria (Onifade *et al.,* 1992), however, it is lower compared to previous reports from Ethiopia, (Assefa *et al.,* 2008; Biadglegne and Abera, 2009; Moges *et al.,* 2002). The other common isolates were *Proteus species* (10.3%) which was also similarly reported from Addis Ababa (Wolday and Erge, 1997) and *CONS* (8.0%) whose isolation rate was in line with what has been reported previously (Moges *et al.,* 2002, Tessema *et al*., 2007).

The observed frequent isolation of *P. aeruginosa* and *S. aureus*from hospitalized patients in the present study was similarly reported from previous studies (Khan and Zaman, 2006).

In the vast majority of patients 79/348 (22.7%) UTI was caused by a single species in this study. However, multiple infections were observed in 9/348 (2.6%) of urine specimens cultured from symptomatic UTI patients. Of these, 1/9 (11.1%) was from out-patients and 8/9 (88.9%) were isolated from in-patients.

The pattern of multiple UTI in this study was characterized by the presence of two different bacteria in a single cultured urine specimen.Some microbiologists regard polymicrobial growth as contamination (Stamm *et al*., 1982). However, polymicrobial growth from mid-stream urine has been found among patients with confirmed bladder infection (Volk *et al*.,1996; Kunin,1994) and is more likely to occur in patients with underlying disorders that interfere with free urine flow and is frequent also in patients with indwelling catheters (Beyene and Abdissa, 2000).

In this study, patient-settings (P=0.016), previous history of hospitalization (P =0.036), diabetes (P=0.05) and pregnancy (P = 0.019) have statistically significant relationship with significant bacteriuria as shown in Table 3.3. Similar findings have been reported in different studies (Assefa *et al.,* 2008; Moges *et al.,* 2002; Wolday and Erge, 1997).

In the present study a large number of the isolates were resistant to ampicillin, chloramphenicol, penicillin, SXT and tetracycline as shown in Tables 3.4a and 3.4b, which is consistent with reports in different studies conducted in Ethiopia (Moges *et al.,* 2002; Tessema *et al.,* 2007; Biadglegne and Abera, 2009) and in Nigeria (Olaitan, 2006).

The remarkably higher prevalence of resistance to the commonly prescribed antibiotics such as ampicillin, chloramphenicol, SXT, penicillin and tetracycline noticed in the present study may be due to the fact that in the study area many antibiotics are available for self medication and being used indiscriminately which is common where some patients buy drugs without prescription which was also reported from Gondar and Bahir-Dar (Moges *et al.,* 2002; Tessema *et al.,* 2007; Biadglegne and Abera, 2009). These problems associated with the increased chance of cross-infection among in-patients, are known to account for circulating resistant bacterial strains (Harding, 1994).

In the present investigation, the susceptibility of the bacterial isolates to ceftriaxone, ciprofloxacin, erythromycin, gentamicin and nalidixic acid was >70% (except most of *Klebsiella species* and *P. Aeruginosa* isolates were resistant to gentamicin) as outlined in Tables 3.4a and 3.4b. This is in agreement with the previous reports from Ethiopia (Moges *et al,* 2002; Tessema *et al.,* 2007; Wolday and Erge, 1997; Teshager *et al*., 2008; Assefa *et al.,* 2008), and elsewhere in Kashmir (Manzoor *et al.,* 2005). In this study, Gram negative bacteria were relatively susceptible to ciprofloxacin (90.9%), nalidixic acid (83.1%), ceftriaxone (80.5%), and gentamicin (70.1%) as shown in Table 3.4a. Similar findings have been reported from previous studies (Wolday and Erge, 1997; Teshager *et al*., 2008; Theodore, 2007; Dimitrov *et al.,* 2004;Kahlmeter, 2003). On the other hand, Gram positive bacteria were relatively susceptible to gentamicin (85.0%), ceftriaxone (80.0%), ciprofloxacin and erythromycin (75.0%) which was also in agreement with the findings of other studies (Moges *et al*, 2002; Assefa *et al.*, 2008).

In the present study, the sensitivity pattern for ciprofloxacin is the highest followed by ceftriaxone and gentamicin. This could be explained by ciprofloxacin is introduced in to use for the treatment of UTIs since the last few years in the study area and might be quite expensive and, therefore, not likely to be purchased without prescription and due to the fact that resistance is by chromosomal mutation rather than by acquisition of plasmids (Volk *et al*.,1996). However, compared to previous studies conducted where ciprofloxacin resistance among the isolates was 1.7 % (Moges *et al*, 2002) and the absence of resistance to gram-negative organisms (Theodore, 2007), 2.3% (Kahlmeter, 2003) and 9 % (Dimitrov *et al*., 2004), the overall resistance which was 12.4% in the present study, implies resistance to this drug has alarmingly increased.

The overall susceptibility to ceftriaxone (80.4%) might occurred because of the reserving tendency of third generation cephalosporin's in the region though the 19.6% resistance investigated in the study, is higher when compared to previous studies in Kuwait (Dimitrov *et al*., 2004) and Turkey (Yuksel et al., 2006) where only 4% and 7.5% resistance respectively was observed.

The present study showed 85.0% susceptibility for Gram positive and 70.1%forGram negative bacterial isolates to gentamicin, which is in line with previous studies from Ethiopia (Moges *et al.,* 2002; Tessema *et al.,* 2008; Biadglegne and Abera, 2009). The relatively lower resistance pattern observed against gentamicin in both gram positive and negative bacteria in the present study (Table 3.4a and3.4b), could be explained by, gentamicin is cheap and effective but requires parenteral administration and, therefore, will not be suitable for treating outpatients. However, it is in contrast to the previous studies which reported 93.3% (Assefa *et al*., 2008), 90.1% (Dimitrov *et al*., 2004) and 99% (Kahlmeter, 2003) susceptibility of Gram negative bacterial isolates to gentamicin, respectively.

P. aeruginosa in this study was not appreciably susceptible to most antibacterial agents. The only antibacterial agent moderately effective was ciprofloxacin (66.7%) (Table 3.4a). Surveillance of *P. Aeruginosa* infections has revealed trends of increasing multidrug resistance, because of its capability of affecting many mechanisms of antibacterial resistance including multidrug efflux pumps, β-lactamases, down regulation of outer membrane porins, enzymatic degradation and target structure alteration (Carmeli et al., 1999). *P. Aeruginosa* is intrinsically resistant to many antibacterials, including many β-lactams, the macrolides, the tetracyclines, co-trimoxazole (trimethoprim/ sulfamethoxazole) and most fluoroquinolones. However, it is not intrinsically resistant to some third-generation cephalosporin's, aminoglycosides like gentamicin, to some fluoroquinolones such as levofloxacin and ciprofloxacin, but it is capable of developing resistance to any of these agents, often under the influence of previous antibacterial exposure (Carmeli et al.,1999; Schweizer, 2003). It was also observed in this study that, all *Klebsiella species* were resistant to ampicillin and tetracycline and only ciprofloxacin (86.7%) and nalidixic acid (66.7%) were effective. *Klebsiella spp* are inherently resistant to ampicillin, cephalosporins and aminoglycosides due to increasing acquisition of R- plasmids (Rennin and Dudncan, 1978). It was also explained that *Klebsiella spp*. produce SHV, a chromosomally mediated pencillinase which can hydrolyze ampicillin and first generation cephalosporin's (Barker, 1999). In this study, *S. aureus* was resistant to all antibiotics particularly to penicillin (75.0%)

as shown in Table 3.4b. It is an established fact that most *S. aureus* strains produce pencillinase and alternative penicillin binding proteins (PBP-2A) helps the organisms to become resistant to most beta lactam antibiotics (Moreillon, 1995).

The present study indicated that the pathogens causing UTI among study subjects in community and hospital set up showed almost the same percentage of resistance for the selectively tested antimicrobial agents except for the observed significant difference in resistance patterns among out-patients and in-patients for ciprofloxacin (p=0.021) and chloramphenicol (p=0.002). However this was in contrary to what has been reported in the previous studies that indicate resistance to antibiotics was more in the hospitalized patients than in the community (Khan and Zaman, 2006). This might indicate the spread of multi- drug resistant strains in the community.

Multiple drug resistance (MDR) was found in 85.6 % of all the isolates to the commonly used antimicrobial agents which is consistent with previous study done in Gondar, (85.7%) (Tessema *et al.*, 2008) but lower than that of 93.1%, from Bahir Dar (Biadglegne and Abera, 2009). However, it is high as compared to other studies elsewhere in the country, from Addis Ababa 74% (Assefa *et al*., 2008) and 68% from Gondar (Moges *et al*, 2002). This may be due to widespread misuse of antibiotics which can cause a shift to increase prevalence of resistant organisms in a community since in Harar people have easy access to most of the antimicrobial agents without prescription in the market, pharmacies, clinics and drug vendors as it was also indicated among major problems identified at Country-level in Ethiopia (Joshi and Miralles, 2006).

CONCLUSION

Significant bacteriuria was detected from 88 symptomatic UTI patients resulting in the overall prevalence of 25.3 %. However, a total of 97 different bacterial uropathogens were isolated making the isolation rate of bacteria from urine 27.9 %. *E. coli* was the dominating bacterial isolate. The results of this study also showed that the etiologic agents of UTIs mainly belonged to Gram-negative enteric bacteria. More than one type of organisms was isolated in 2.6 % of urine specimens cultured. Significant bacteriuria was significantly associated with Patient settings, previous history of hospitalization, pregnancy and diabetes.

Even though amoxicillin-clavulanic acid and nitrofurantoin were reported to have very effective activity against urinary isolates in previous studies (Assefa *et al.*, 2008; Moges *et al*, 2002) they were not available in the study area which limited the present study to assess their effectiveness.

However, single and multiple drug resistance to the available commonly used antibiotics in the study area was found to be very high leaving clinicians with a very few choices of drugs for the treatment of UTIs. Therefore, it is critical that use of *antimicrobial* agents with in hospitals, public healthcare providers as well as private ones should be reviewed and further studies to find out the overall resistance patterns and their possible causes and associated factors in the region at large need to be carried out. In the present study, it is indicated that the majority of bacterial isolates were sensitive to ciprofloxacin, ceftriaxone, nalidixic acid and gentamicin. Thus, these drugs appear to be effective against uropathogens in the study area. These antibiotics should however be used with caution because of the emerging low level of resistance which may portent great danger for their future use.

RECOMMENDATIONS

The following recommendations are forwarded based on the findings of the present study:

- Further studies on a larger scale in the future in order to monitor any changes in the sensitivity patterns and to explore the causes for increased drug resistance of pathogens causing urinary tract infection among UTI patients in the study area is recommended.

- The use of antimicrobial agents with in hospitals and all other responsible health institutions should be reviewed and policy of banning the sale of antibiotics without prescription as well as developing strict hospital disease control and antibiotic usage policy in the study area needs to be considered.
- Improvement of the laboratory services capable of doing culture and sensitivity in all urinary isolates before subscribing any drugs and during follow up of recurrent UTI that may help to contain the spreading of drug resistance in the study area is also recommended.
- Based on the results of present study, if culture facilities are not available, ciprofloxacin, ceftriaxone and gentamicin can be used for empirical therapy of UTI.
- Creating awareness of the community will also have a significant role to limit drug resistance problem.

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