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Community and Hospital-Acquired UTI Pathogens: Prevalence and Susceptibility Pattern in Sana'a City, Yemen: The Last Bullet

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Original Research Article

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Abstract: Urinary tract infection (UTI) is one of the most common infectious diseases globally. An increasing antimicrobial resistance among Community-acquired (CA) and Nosocomial UTI has been rapidly growing. Cross-sectional, analytical and descriptive study was conducted to investigate the current in vitro susceptibility pattern of the clinically isolated bacteria among Community and Hospital-acquired (HA) UTI. Patient data for 421 urine specimens were collected from the case records during October 2016 to March 2017. Significant growth was yielded from 170 of urine specimens. Kirby-Bauer disk diffusion method was used for detection antibiotic susceptibility pattern for all isolates. Of the total 170 (40.4%) culture positive samples, 51.2% and 48.8% were CA and HA UTI respectively. The culture positivity of UTI among the female was (44.1%) compared to (55.9%) among the male. There was a significant difference in resistance pattern between CA and Nosocomial UTI. The distribution of the isolated pathogens were (51.2%) and (48.8%) in CA and HA respectively. The predominant bacterial isolate was *Escherichia coli* (43.5%) in both cases of community and nosocomial UTI. However, *Klebsiella pneumoniae* (69.0%) was mostly isolated from HA-UTI while *Staphylococcus aureus* (80.0%) was mostly detected in CA-UTI. The recent study revealed high resistant rates of UTI among HA as compared to CA. This study revealed that more than 90% of HA-UTIs isolated pathogens were resistant to broad-spectrum Penicillins, Cephalosporins, Quinolones, and Macrolides. Contrarily, high rates of bacterial sensitivity was found towards Imipenem (82.9%), Nitrofurantoin (72.4%), Ertapenem (70.7%), and Amikacin (67.1%). Even if *Escherichia coli* remains the major pathogen in UTI, the resistance pattern of CA-UTI is frightening in our country. Nitrofurantoin is the only oral drug that retained reasonable activity against most UTI pathogens. Imipenem and Ertapenem remain effective for UTI bacterial isolates. The changing of UTI etiological agents was observed in the current study.
Keywords: UTI, Antibiotic susceptibility, Nosocomial, Taiz University.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections. Microorganisms harboring the urethra and forming an integral part of intestinal tract normal flora are the mostly causative agents of UTIs [1]. It affects millions of people annually and is a serious threat to public health [2]. Since most gram-negative bacteria belonging to *Enterobacteriaceae* family are involved in UTI, *Escherichia coli* contribute to the largest percentage of UTI incidence [3].

The prevalence of Community-acquired (CA) UTI due to extended spectrum β-lactamase (ESBL) producing *Escherichia coli* strains is increasing worldwide [4]. In addition to that, hospital-acquired (HA) infections which are defined as the nosocomial-acquired infections that are typically not existing or incubating at the time of admission. The pattern of nosocomial UTI has changed in the latest years that reflect the progress in the evolution of antibiotics. According to current definitions, more than 30% of nosocomial infections are UTIs [5]. The significance of gram-negative bacteria has recently increased as the entrance of broad-spectrum antibiotics because these organisms often carry multi-antibiotic resistance (MDR) naturally [6]. The *Escherichia coli* responsible for about 85% of CA-UTI and 50% of nosocomial UTI [7]. Many risk factors such as gender and underline diseases of the patients may influence the prevalence and the type of infecting organism [8].

Generally, one of the primary tasks of the clinical microbiology laboratory has been to measure antibiotic resistance developments among UTI inpatient versus outpatient. [1] Therefore, it is essential to note that use of antibiotics in UTI treatment in each district must be established on antibiotic susceptibility pattern of that region. Preliminary treatment of UTI by antibiotics is commonly done experimentally hereafter accurate information of antibiotic susceptibility pattern of local strains is essential. Today, drug resistance among UTI pathogens has increased universal [9]. Type of selective antibiotic for the empirical treatment of UTI is discussed because 20-50% of *Escherichia coli* strains, even in developed nations have now become resistant to first-line antibiotics [10].

Few studies were conducted in Yemen between (2005-2016), they were focused on UTI among special cases like pregnant women (three papers) and the remaining distributed between children and renal transplant recipients patients. A single retrospective study was carried out from 2003 to 2006 and revealed that 35.4% of the isolated pathogens belong to *Escherichia coli* showed high resistance against quinolones and penicillin and there was no resistance against macrolides. Another study was conducted at 2014 in Sana'a City, Yemen by Alkhyat and Maqtari in 2014 documented that (74.3%) of the studied population had UTI [11–17].

To our knowledge, no previous study involves a comparison between community and HA-UTI was carried out in Yemen. In addition, due to the increasing antibiotic resistance among UTI pathogenic bacteria, it is essential to have a continuously updated knowledge of the type and the prevalence of the UTI causative agents to selected patient locations, inpatient versus outpatient, as well as to identify their sensitivity pattern in order to choose the accurate treatment regime [18]. This will play an important role in appropriate treatment and decreasing the unwisely use of broad-spectrum antibiotics and accordingly, will prevent an increase in microbial resistance and will decrease UTI-related costs. [18] Therefore, the present study was conducted to investigate the current in vitro susceptibility pattern of the clinically isolated bacteria between CA and HA-UTI.

MATERIALS AND METHODS

Study design

Cross-sectional, analytical and descriptive study.

Location, target population and study period

The current study was carried out on bacterial isolates that obtained from sub-culturing of different clinical samples that referred for routine laboratory investigating along with physician orders in the hospitals or clinics of Sana'a city, Yemen during the period between October 2016 to March 2017. Related information like gender and ward of admission for all selected isolates were collected from request form and medical records.

Target pathogenic bacteria

All common pathogens isolated from clinical specimens were subjected to microbial investigation during the period of the study. Only aerobic and/or facultative anaerobic Gram-negative *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa* and Gram-positive *Staphylococcus aureus* will be included in this study. Duplicate samples were excluded from the study.

Methods

Laboratory Identification of Isolates

A total of 170 microorganisms were prospectively isolated and identified from urine specimens during the period from October 2016 to March 2017, where the isolates were submitted for routine microbiological analysis from both out and inpatients. Organisms, which were daily isolated from clinical specimens, are identified by culture using standard microbiological techniques. Confirmation to the species level was done by using API 20 E diagnostic system (bioMerieux, France) and according to manufacturer instructions [1].

Antimicrobial susceptibility test

After identification, by standard microbiological technique was done for all isolates, their antibiotic susceptibility pattern was detected by disk diffusion method according to the Kirby–Bauer method on Muller Hinton agar (Oxoid Ltd. Hampshire, United Kingdom) [1]. Thirty antimicrobial agents were tested and standardized according to the MIC breakpoints recommended by the National Committee for Clinical Laboratory Standards with CLSI guidelines [19, 20], Using the following antimicrobial drugs; Penicillin 10U, Ampicillin 10µg, Piperacillin 100µg, Ticarcillin 75µg, Carbenicillin 100µ, Amoxiclav 20/10µg, Piperacillin-tazobactum 100+10µg, Aztreonam 30µg, Imipenem 10µg, Ertapenem 10µg, Cefradine 30µg, Cefazolin 30µg, Cephadroxil 30µg, Cephalothin 30µg, Cefaclor30µg, Cephalexin30µg, Cefpirome 30µg, Cefuroxime 30µg, Ceftizoxime 10µg, Cefoxitin 30µg, Cefotaxime 30µg, Ceftazidime 30µg, Cefepime 30µg, Nalidixic acid 30µg, Nitrofurantoin

300µg, Ciprofloxacin 5µg, Norfloxacin 10µg, Ofloxacin 5µg, Pefloxacin 5µg, Lomefloxacin 10µg, Levofloxacin 5µg, Moxifloxacin 5µg, Erythromycin 15µg, Azithromycin 15µg, Roxithromycin 15µg, Amikacin 30µg, Kanamycin 30µg, Gentamicin 10µg, Tobramycin 10µg, Tetracycline 30µg, Minocycline 30µg, Doxycyline30µg, Co-trimoxazole 25µg, Chloramphenicol 30µg. All of the antibiotic discs were manufactured by Oxoid Ltd. Hampshire, United Kingdom. The isolated microorganisms and their antimicrobial resistance patterns were analyzed with consideration of the admission gender of the patients. Only a single positive culture per patient was included in the study.

Statistical analysis

A bacterial resistance of all isolates was determined and was expressed as a percentage. Descriptive statistics of antibiotics activity and other characteristics of the isolated bacterial population were calculated. A *P* value less than 0.05 was calculated to be statistically significant. The statistical difference was also evaluated by applying the Chi-square test. The Statistical Package for Social Sciences (SPSS) software package version 22 did all the statistical analysis. (SPSS Inc. Chicago, Illnois, USAT).

RESULT

A total of 421 specimens were received for culture and sensitivity during the study period. Among these, 170 samples (40.4%) yielded significant bacterial growth; 251 samples (59.6%) showed no growth. As shown in Table-1, the frequency of UTI infected males was 95 ⁄ 170 (55.9%) and females was 75 ⁄ 170 (44.1%). Out of 170 bacterial causative microorganisms isolated from UTI were confirmed as *Escherichia coli* 74 (43.5%) followed by *Klebsiella pneumoniae* 42 (24.7%), *Pseudomonas aeruginosa* 34 (20.0%) and *Staphylococcus aureus* 20 (11.8%). All of these isolates were subjected to antibiotics susceptibility testing and hence included in the analysis. However, the difference in the prevalence of isolated *Escherichia coli* in relation to gender was statistical significance among females ($p < 0.05$ and OR=2.1) (Table-1).

The recent study revealed that 87(51.2%) were outpatients and 83 (48.8%) were inpatients that showed to be statistically significant. However, *Escherichia coli* was found more frequently encountered pathogens, in CA (41 isolates) as well as among HA isolates (33 isolates), followed by *K. pneumonia* and *Pseudomonas aeruginosa* (29 and 17 isolates) among HA and CA respectively. While, the rate of *Klebsiella pneumoniae* was found to be statistically significant ($p < 0.05$ and OR=3.1) and more frequently isolated, among inpatients than in outpatients, followed by *Pseudomonas aeruginosa* and *Staphylococcus aureus* (Table-2).

Antibiotic susceptibility pattern

The recent study revealed high resistant rates of UTI among inpatients (HA) as compared to outpatients (CA) as shown in (Table 2). The difference in the resistance rates between CA and HA isolates showed significant concerning Penicillin, Ampicillin, Amoxicillin, Ticarcillin, Piperacillin, Carbenicillin, Amoxiclav, first, second and third generations cephalosporins except for Cefotaxime, and Quinolones except for Nalidixic acid, Nitrofurantoin, and Ofloxacin ($P < 0.0005$).

The recent study revealed that more than 90% of HA-UTIs isolated pathogens were resistant to broad-spectrum Ampicillin (95.2%), amoxicillin (97.6%) first-generation cephalosporins such as Cefradine (96.4%) Cefazolin (94.0%) and Cephalexin (94.0%) and second-generation cephalosporin Cefaclor (91.5%), Erythromycin (94.0%) and Roxithromycin (96.4%), compared to resistant rates ranged from 79% to 87% of CA-UTIs isolates.

On other hand, less HA resistant rates was found towered Imipenem (21.7%), Nitrofurantoin (26.5%), Amikacin (28.9%) Ertapenem (30.1%), compared to 12.6%, 28.7, 36.8% and 28.7% of CA isolates were resistant to Imipenem, Nitrofurantoin, Amikacin and Ertapenem respectively. While the remaining antibiotics tested showed moderate to marked activity against UTI isolated pathogens.

Table-1: Distribution of UTI isolates in relation to gender.

Isolates	Male		Female		Total		χ^2	*OR*	*CI*	*P*
	N	%	N	%	N	%				
E. coli	34	35.8	40	53.3	74	43.5	5.2	2.1	0.2-1.6	0.022
K. pneumoniae	24	57.1	18	42.9	42	24.7	0.04	0.9	0.5-1.9	0.850
P. aeruginosa	28	82.4	6	17.6	34	20.0	12.1	0.2	0.1-0.5	0.001
S. aureus	9	45.0	11	55.0	20	11.8	1.1	1.6	0.6-4.2	0.297
Total	95	55.9	75	44.1	170	100.0	13.6			0.003

* Statistically significant, χ^2: Chi-square, OR: Odd ratio, N: number, CI: Confidence interval, *p*: probability. ($\chi^2 \geq 3.84$, $p < 0.05$: significant). CA: Community acquired, HA: Hospital-acquired.

Table-2: Pattern of UTI resistant in general and among CA (OP) and HA (IP) isolates

Antibiotics groups	Antibiotic 44	Total (N=170)		HA (N=83)		CA (N=87)		χ^2	*OR*	*CI*	*P*
		N	%	N	%	N	%				
Penicillins	Penicillin	163	95.9	83	100.0	80	92.0	7.0	--	--	0.008
	Ampicillin	153	90.0	79	95.2	74	85.1	4.8	3.5	1.1-11.1	0.028
	Amoxicillin	149	87.6	81	97.6	68	78.2	14.8	11.3	2.5-50.3	0.000
	Aztreonam	89	52.4	51	61.4	38	43.7	5.4	2.1	1.1-3.8	0.020
	Ticarcillin	128	75.3	69	83.7	59	67.8	5.4	2.3	1.1-4.9	0.021
	Carbenicillin	129	75.9	70	84.3	59	67.8	6.3	2.6	1.2-5.4	0.012
	Piperacillin	110	64.7	64	77.1	46	52.9	10.9	3.0	1.6-5.8	0.001
Beta-lactam inhibitors	Piperacillin-tazobactam	55	32.4	31	37.3	24	27.6	1.9	1.6	0.8-3.0	0.174
	Amoxiclav	95	55.9	56	67.5	39	44.8	8.8	2.6	1.4-4.8	0.003
Carbapenems	Imipenem	29	17.1	18	21.7	11	12.6	2.5	1.9	0.8-4.3	0.117
	Ertapenem	50	29.3	25	30.1	25	28.7	0.04	1.1	0.6-2.1	0.843
Cephalosporins	Cefradine	156	91.8	80	96.4	76	87.4	4.6	3.9	1.0-14.4	0.029
	Cefazolin	144	84.7	78	94.0	66	75.9	10.8	5.0	1.8-13.9	0.001
	Cephalexin	148	87.1	78	94.0	70	80.5	6.9	3.8	1.3-10.8	0.009
	Cephalothin	141	82.9	79	95.2	61	71.3	17.2	8.0	2.6-22.1	0.000
	Cefaclor	145	95.3	76	91.5	69	79.3	5.1	2.8	1.1-7.2	0.020
	Cefpirome	97	57.1	55	66.3	42	48.3	5.6	2.1	1.1-3.9	0.018
	Cefuroxime	132	77.6	72	86.7	60	69.0	7.7	2.9	1.4-6.4	0.004
	Cefoxitin	126	74.1	69	83.1	57	65.5	6.9	2.6	1.3-5.4	0.009
	Ceftizoxime	126	74.1	69	83.1	57	65.5	6.9	2.6	1.3-5.4	0.009
	Cefotaxime	127	74.7	66	79.5	61	70.1	2.0	1.7	0.9-3.3	0.159
	Ceftazidime	137	80.6	74	89.2	63	72.4	7.6	3.1	1.4-7.2	0.006
	Cefepime	97	57.1	55	66.3	42	43.3	5.6	2.1	1.1-3.9	0.018
Quinolones	Nalidixic acid	142	83.5	72	86.7	70	80.5	1.2	1.6	0.7-3.7	0.269
	Ciprofloxacin	117	68.8	67	80.7	50	57.5	10.7	3.1	1.6-6.2	0.001
	Norfloxacin	115	67.6	66	79.5	49	56.3	10.4	3.0	1.5-6.0	0.001
	Ofloxacin	108	63.5	56	67.5	52	59.8	1.1	1.4	0.8-2.6	0.297
	Pefloxacin	106	62.4	61	73.5	45	51.7	8.6	2.6	1.4-4.9	0.003
	Lemefloxacin	110	64.7	66	79.5	44	50.6	15.6	3.8	1.9-7.5	0.000
	Levofloxacin	93	54.7	57	68.7	36	41.4	12.8	3.1	1.7-5.8	0.000
	Moxifloxacin	77	45.3	50	60.2	27	31.0	14.6	3.4	1.8-6.3	0.000
Macrolides	Erythromycin	152	89.4	78	94.0	47	85.1	3.6	2.7	0.9-8.1	0.059
	Azithromycin	111	65.3	58	60.9	53	69.9	1.5	1.5	0.8-2.8	0.220
	Roxithromycin	162	95.3	80	96.4	82	94.3	0.4	1.6	0.4-7.0	0.512
Aminoglycosides	Amikacin	56	32.9	24	28.9	32	36.8	1.2	0.7	0.4-1.3	0.275
	Kanamycin	102	64.4	46	55.4	56	64.4	1.4	0.9	0.4-1.3	0.234
	Gentamicin	74	44.7	45	54.2	31	34.6	5.9	2.1	1.2-4.0	0015
	Tobramycin	120	70.6	62	74.7	58	66.7	1.3	1.5	0.8-2.9	0.251
Tetracycline	Tetracycline	130	76.5	65	78.3	65	74.7	0.3	1.2	0.6-2.5	0.580
	Minocycline	78	45.9	47	56.6	31	35.6	7.5	2.4	1.3-4.3	0.006
	Doxycyline	58	57.6	51	61.4	47	54.0	1.0	1.4	0.7-2.5	0.328
Others	Cotrimoxazole	107	62.9	60	72.3	47	54.0	6.1	2.2	1.1-4.2	0.014
	Chloramphenicol	68	40.0	37	44.6	31	36.6	1.4	1.5	0.8-2.7	0.234
	Nitrofurantoin	47	27.6	22	26.5	25	28.7	0.1	0.9	0.5-1.8	0.745

* Statistically significant, χ^2: Chi-square, OR: Odd ratio, N: number, CI: Confidence interval, *p*: probability. ($\chi^2 \geq 3.84$, $p < 0.05$: significant). CA: Community acquired, HA: Hospital-acquired.

DISCUSSION

The present study offers valuable information to compare and monitor the status of antimicrobial resistance among UTI pathogens to improve effective antibiotic empirical therapy. This study showed a high prevalence rate of UTIs was 40.4% among our patients. Although, the prevalence rate of UTI in this study correlates with other studies done in by Stefaniuk *et al*., [21] in Poland (50%) and Majeed and Nair in India (56.66%) or that done locally among pregnant women in Hodeidah City, Yemen by AL-Kadassy (54.5%) during 2016 and much lower than that reported (74.3%) by Alkhyat and Maqtari during 2014 in Yemen [16, 17]. On other hand, our result was higher than (9.2%) documented by Ethiopian researchers [22], (24.7%) that reported by Ahmed *et al.* in India [23], and that (30%) presented by Al-Haddad [12] in his study among pregnant Yemeni women in Al-Mukalla district [12]. Growing antimicrobial resistance has been recognized globally [1, 18, 19, 24]. The expected reason for this difference in UTI prevalence could be due to the differences in sample size and methodology among these studies.

The prevalence of UTI in males 95 (55.9%) was higher than females 75 (44.1%) in similarity to another study [14]. In contrast, our result was dissimilar with other findings which showed that the rate of UTI is greater in females as compared to males [2, 9-11, 15, 17, 21, 25-27]. The possible reason is that the urinary tract operations that might show bias in male due to the increased risk compared to women that lengthier duration in hospital [8] the other one cause is might be due to the difference in the target setting [14]. On other hand, the high prevalence of UTI in females is due to the shorter urethra, the closeness of the urethral opening to the anus and, sexual intercourse, bad personal hygiene, and incontinence [2, 9-11, 15, 17, 21, 25, 26].

In this study, the prevalence of Gram-negative bacilli constituted 88.2% of the total isolated bacterial whereas the rate of Gram-positive cocci constituted 11.8%. The common source of pathogens causing UTI is intestinal flora that exposed to too many antibiotic classes for UTI and other than UTI bacterial diseases treatment [1]. *Escherichia coli* (43.5%) was found to be the most prevalent pathogens among Gram-negative bacteria in the significant urine specimens of UTI in both, HA as well as CA isolates. This result is consistent with previous reports from other studies [2, 5-12, 14-16, 18, 21-23, 25, 25-29].

Other isolated bacteria from UTI cases in this study were *Klebsiella pneumoniae* (24.7%), *Pseudomonas aeruginosa* (20.0%), and *Staphylococcus aureus* (11.8%) in general. These results correlate with others in which *Klebsiella pneumoniae* was reported as the second most frequently isolated organism in UTI [2, 9, 17, 21, 25, 27, 30]. Furthermore, our *Klebsiella pneumoniae* isolates were the second most common (69.0%) and the prevalence was significantly higher in HA-UTI. These findings were correlated with other reports. [8, 18, 22, 31] On other hand, our results were not correlate with other reports in which the second most common bacterial isolate in HA-UTI was described as, *Pseudomonas aeruginosa* in India [23], *Staphylococcus saprophyticus* in Yemen [11], *Candida* spp in Turkey [32], and *Enterococcus* spp in Spain [33]. The high prevalence of *Klebsiella pneumoniae* UTI in this study can be clarified by its ability for adaptation to the hospital environment and can survive longer than other bacteria, enabling cross-infection within hospitals. [34] The change in the etiology of UTI was observed in this study when compared with other studies in Yemen that discussed above.

Pseudomonas aeruginosa isolated pathogens were equally distributed between our community and nosocomial groups but among gender, they were much greater in males (82.4%) than the rate in females was (17.6%) that found to be statistically significant. These findings were similar to previous studies [17, 27, 30] but in contrast to another study [25]. The presence of *Pseudomonas aeruginosa*, 20.0% of all isolates was unfamiliar as it is considered to be an HA pathogen.

Even though a smaller proportion of UTI was caused by *Staphylococcus aureus* (11.8%). Our results indicate that *Staphylococcus aureus* bacterial isolates were the next UTI pathogens after *Escherichia coli*, causing about (18.40%) UTI in our community. These findings were consistent with other reports [26, 28]. On other hand, our findings were not correlate with other reports, in which, the second most common bacterial isolate in HA-UTI was described as, *Citrobacter* spp in India [25], *Klebsiella* spp in Italy, Cameroon, India, and Nigeria [6, 9, 27, 30] and *Enterococcus* spp in India and Spain [10, 33].

Penicillin and Ampicillin is a bad choice for treatment of UTI in both community and hospital situations. A relatively high rate of resistance to most antibiotics tested was shown in this study, more significantly associated with HA-UTI than CA-UTI. Resistance to the first line of antibacterial agents, Ampicillin (90.0%), Cotrimoxazole (62.9%) and Amoxiclav (55.9%) was particularly frightening. These drugs were not considered a first-choice drug for UTI. [6] This finding is in accordance with results from other studies for Ampicillin and Amoxiclav [2, 10, 23, 27, 34] and for Ampicillin [2, 9, 16, 22]. Dissimilar results to our finding were reported in other studies [15, 21, 35]. These drugs cannot be used as empirical therapy for UTI especially in the study area [22]. The prevalence of resistance could be due to that the Yemeni people having easy access to antibiotics and therefore greater intake that stresses the development of resistance.

Both carbapenems (Imipenem and Ertapenem) of the second line drugs (group B) according to CLSI [20] Guidelines, tested in this study, among community and HA-UTI, were found to have a good level of sensitivity against all isolated UTI pathogens (82.9% and 70.7% respectively). These antibiotic susceptibility results closely related to other studies [9, 25]. In another study, Imipenem was found to be 100% sensitive, against highly resistant UTI bacterial isolates except for *Klebsiella pneumoniae* (66.7%) [26].

Almost all analyzed Cephalosporins in this study were detected to have poor activity against UTI pathogens particularly among HA-UTI which was statistically significant except for Cefotaxime. We found that, the 4th generation cephalosporins Cefpirome and Cefepime, have to be effective against a good population of community isolates 56.7%, but the high rate of resistance was found against hospital isolates 66.3%. These findings were constant with many reports in developing countries like as well as in Yemen [7, 9, 14, 34]. In addition to that highest resistance that was determined among the 1st and 2nd generation cephalosporins that range between (82.9-95.3%), the shocking finding in this study is the resistance to the 3rd generation cephalosporin alongside with the highest resistance was seen against Ceftazidime (80.6%) followed by Cefotaxime (74.7%) among all UTI pathogens isolates. Therefore, many of ESBL producer's bacteria were present among our UTI isolates or the prolonged antibiotic abused and/ or misuse may induce the resistant strains [20, 25, 34]. Conversely, a study done in developed country documented that UTI over 90 % of their isolates were susceptible to the 3rd generation [21]. This high rate of resistance among our country was mostly due to the extensive, uncontrolled and undiscriminating use of these antibiotics [14, 32]. First- and second-generation oral Cephalosporins and amoxicillin-clavulanic acid show regional variability [36].

Even though the Infectious Disease Society of America (IDSA) guidelines [36] and consider the most effective antibiotics were Ofloxacin and Levofloxacin. The tested Quinolones in this study showed the highest resistance more than 60% mainly among HA-UTI isolates except for Moxifloxacin that has an acceptable sensitivity (45.3%) against, particularly CA bacteria. This high prevalence of resistant strains against Quinolones was also proposed by other studies done in India, Spain, and Turkey [25, 31, 32] and by other studies were done in Yemen [14, 34]. Our result about the Quinolones did not accordance with other studies, which indicated that they were high sensitivity [13, 14, 28]. Undiscriminating use of Quinolones must be controlled and establishment the strategies against increasing resistance of pathogens to these antibiotics should be done[25]. In addition to the uncontrolled consumption of antibiotic, the veterinary practice may play another potential reason for the appearance of resistant strains. Our results thus recommend that empirical treatment with Quinolones must no longer be suitable.

Alternatively, an acceptable susceptibility (72.4%) in both groups were detected to Nitrofurantoin. It is suitable empiric antimicrobial choices for hospitalized and for CA-UTI that correlate with other studies [2, 3, 6, 9, 10, 14, 18, 21-23]. In contrast to previous, study of UTI among children [15, 29]. Low resistance rate was noticed here because this drug is not easily reachable and moderately expensive compared to others or due to its unique structure and mechanism of action, concentrating only in the urinary tract [9]. Thus, these drugs could be considered as alternative options in the empirical treatment of UTIs [9, 10].

Amikacin was found to have good activity against HA isolates (71.1%) UTI compared to 63.2% in CA-UTI isolates. This result correlate with the findings of other previous reports that documented excellent Amikacin activity particularity among Gram-negative bacilli [10, 21, 30]. On other hand, we find that Gentamicin shows intermediate to high sensitivity (65.4%) mainly among CA-UTI in consistence to other studies, which reported high to an excellent activity of Gentamicin [9, 16, 22]. The main cause for low resistance pattern may be due to that these antibiotics have not been over-used because the way of administration difficult its use as empiric therapy in community locations [30].

Chloramphenicol have a good activity against among our UTI isolates (60%). The trend of Chloramphenicol resistance in HA group was more than that of CA. Excellent finding, than ours, was reported recently by AL-Kadassy *et al*., [16], that (93.3%) of the common isolated pathogens were sensitive to Chloramphenicol among pregnant women in Yemen. Nevertheless, our result was in agreement with previous reports Al-Mukalla district, Yemen [12, 14]. However, it is not advised treatment in UTIs due to its serious side effect. The low resistance rate of Chloramphenicol is possibly because it's less common use over the years that it has retained its sensitivity. In regarding to Tetracycline and Nalidixic acid, the resistance rate in our finding were 76.5% and 83.5% respectively that showed to be similar to that documented by AL-Kadassy in Yemen [16] but lower rate than other study in Cameroon and in Ethiopia [27] for Nalidixic acid among UTI isolates. On the contrary, Mohanna and Raja'a suggested in 2005 that Nalidexic acid can be used as a first line empiric treatment and/or prophylaxis of UTI in Yemeni children [15].

CONCLUSION

The most common isolated pathogen is *Escherichia coli* in both community and HA-UTI. Changing etiology of UTIs in our country was observed. The high resistance pattern of UTI pathogens among inpatients was greater than that among outpatient; however, this may lead to the spreading of cross-resistant strains. The most effective drugs for UTI Nitrofurantoin, Imipenem, Ertapenem, piperacillin-tazobactam, Amikacin and to lesser extents the 4th generation cephalosporins. Urine culture and awaiting antibiotic sensitivity reports is necessary.

RECOMMENDING

We emphasis antimicrobial susceptibility patterns must be identified before selecting an agent and re-evaluation of empiric treatment of UTI is needed. Further comprehensive studies required with the usage of phenotypic and genotypic method assay for ESBL confirmation as well as for resistance pattern investigation. The reasons underlying the high prevalence of nosocomial UTIs should be investigated. Additional policies for intervention, such as reducing total antibiotic exposure in a human being, animal, and environment, are needed immediately. Development of regional investigation plans is necessary for detecting, implementation, and continuous evaluation of antibiogram guidelines.

DECLARATIONS

Ethical considerations

Ethical clearance was obtained from the Faculty Ethics Committee of Faculty of Medicine and Health Sciences, Taiz University, Taiz, Yemen. All obtained demographic data was treated confidently.

Consent for publication: Not applicable

Limitation

Missing of some, demographic data and other risk factors associated with UTIs.

Availability of data and materials

The data that support the findings of this study are available from the hospitals or clinics of Sana'a city but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the hospitals or clinics of Sana'a city.

Conflict of interest

We declare that the authors have no conflict of interest. All authors read and approved the final manuscript.

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Authors' contribution

HA contributed to study design, data collection and analysis, and manuscript writing and review. TA contributed to study design, data collection and analysis, and manuscript TH contributed to data interpretation and manuscript drafting and review. AA contributed to manuscript review.LA data collection assistant.

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