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Multidrug resistant *Escherichia coli* strains isolated from urine sample, University of Gondar Hospital, Northwest Ethiopia

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ABSTRACT

Objective: To assess multidrug resistant (MDR) *Escherichia coli* (*E. coli*) isolates from patients with urinary tract infection.

Methods: From February to June 2014, a cross sectional study was conducted among urinary tract infection patients at the University of Gondar Hospital. Culture and disk diffusion method were used for *E. coli* isolation and to determine the antibiotic susceptibility patterns. Data were entered and analyzed using SPSS version 20. $P < 0.05$ was considered as statistically significant.

Results: A total of 112 *E. coli* isolates were identified and the rate of isolation was higher among female participants (28.7%; $P = 0.03$). Of the isolates, 104 (92.9%) were MDR *E. coli*; and the isolates showed high resistance rates towards ampicillin (99%), cotrimoxazole (69%), chloramphenicol (58.7%), gentamycin (56.7%) and ceftazidime (55.8%). However, comparative isolates showed low resistance rates to ciprofloxacin (1%), cefepime (8.7%), and ceftriaxone (11.5%). Moreover, resistance rates of MDR *E. coli* isolates were significantly higher than non-MDR strains for ceftazidime (55.8% versus 12.5%; $P = 0.015$), and ampicillin (99% versus 87.5%; $P = 0.018$).

Conclusions: High prevalence of MDR *E. coli* isolates was observed in this study. Regular monitoring of antibiotic resistance rates is necessarily required to improve and revise empirical antibiotic therapy protocols.

1. Introduction

Urinary tract infections (UTIs) are one of the most common clinical problems for consultation and antibiotic prescription and often associated with significant morbidity and mortality worldwide[1]. Excessive and/or inappropriate use of antibiotics in treating UTIs in developing countries, including Ethiopia becomes a major problem, which are responsible for the emergence and spread of multidrug resistant (MDR) urinary bacteria[2,3]. Gram negative bacteria, especially *Escherichia coli* (*E. coli*) is the most prevailing cause of both community and hospital acquired UTIs. UTIs caused by MDR *E. coli* isolates are a major public health issue, since the efficacy of many antimicrobial agents has been compromised, thus reducing the therapeutic options significantly and making the provision of an appropriate antimicrobial therapy more challenging[4,5].

Updated knowledge of the burden of the causal bacteria and its antimicrobial susceptibility pattern are substantial for proper antibiotic selection and appropriate therapy. Since those groups of bacteria are the main cause of UTIs and possess several mechanisms to diminish the efficacy of currently available antibiotics, the aim of the present study was to assess the prevalence of MDR E.coli among patients with UTI.

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The study protocol was performed according to the Helsinki declaration and approved by the Research and Ethics Committee of School of Biomedical Laboratory Sciences. Informed written consent was obtained from each subject.

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2. Materials and methods

2.1. Bacterial isolates

A total of 112 non-duplicate *E. coli* uropathogens were collected from Gondar Hospital from February to May 2014. Antibiotic susceptibility testing was done by Kirby-Bauer disk diffusion test method on Muller-Hinton agar plate and interpreted according to Clinical Laboratory and Standards Institute guidelines, where the following antibiotics (from Oxoid, England) were tested: cefotaxime (CTX; 30 μg), ceftriaxone (CTR; 30 μg), cefepime (CPM; 30 μg), ceftazidime (CAZ; 30 μg), cefpodoxime (CPD; 30 μg), ciprofloxacin (CIP; 5 μg), tetracycline (TE; 30 μg), chloramphenicol (C; 30 μg), amoxicillin-clavulanic acid (AMC; 30 μg), nalidixic acid (NA; 30 μg), gentamycin (GEN; 10 μg), ampicillin (AMP; 10 μg) and trimethoprim-sulfamethoxazole (SXT; 25 μg). Quality control was performed using *E. coli* ATCC 25922. An isolate was considered MDR if it was resistant to at least two of the antibiotic agents tested from different classes of antimicrobials[6,7].

2.2. Ethical clearance

This study was started after approved by the Research and Ethics Committee of School of Biomedical Laboratory Sciences and informed consent was obtained from each subject.

2.3. Statistical analysis

Data were analyzed using SPSS version 20 software. Associations were measured using *Chi*-square test. *P*-values < 0.05 were considered as statistically significant.

3. Results

3.1. Prevalence and antibiotic resistance pattern of MDR *E. coli*

One hundred and twelve *E. coli* isolates were identified from 112 (25.3%) patients. The isolates were tested for antimicrobial susceptibility and 104 (92.9%, 95% confidence interval: 87.3%–97.4%) of them showed resistance to two or more antibiotics. Among MDR strains, only 5 (4.8%) isolates were resistant to 3 antibiotics, and the rest 99 (95.2%) were resistant to four and more antibiotics (Table 1).

Table 1
Antibiotic resistance phenotype of MDR *E. coli* isolates from UTI patients (n = 104). n (%).

Antimicrobial resistance phenotype	No of strains
AMP, AMC, NA	5 (4.8)
AMP, SXT, AMC, CPD	28 (26.9)
AMP, C, GEN, CAZ, CTX	24 (23.1)
AMP, SXT, C, GEN, CAZ, TE	32 (30.8)
AMP, SXT, TE, AMC, CPD, NA, CTR	9 (8.7)
AMP, C, TE, AMC, CPD, NA, CPM, CTR/GEN	4 (3.8)
AMP/CIP, C, TE, AMC, CPD, NA, CPM, GEN, CAZ	2 (1.9)

The overall resistance profile of *E. coli* isolates are shown in Figure 1. High resistance rate was observed to AMP (98.2%) followed by SXT (64.3%), and C (54.5%). Comparatively, it showed low resistance rate to CIP (0.9%), CPM (8%), and CTR (10.7%).

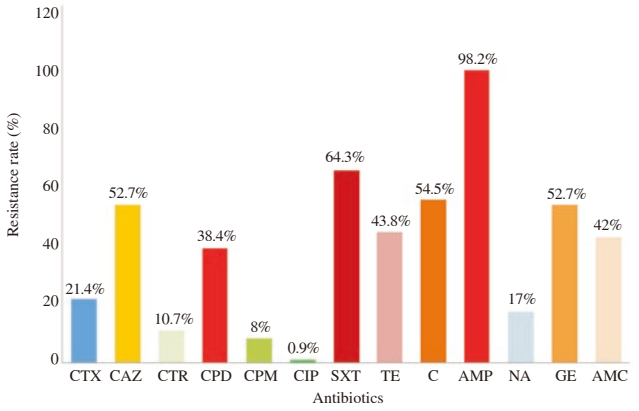

Figure 1. Resistance rate of *E. coli* isolates from UTI patients.

3.2. Resistance rates of MDR *E. coli* versus non-MDR *E. coli*

Additionally, the resistance rates of MDR *E. coli* versus non-MDR *E. coli* were presented in Table 2. The overall antibiotic resistance rates of MDR *E. coli* isolates were significantly higher than non-MDR strains for CAZ (55.8% versus 12.5%; P = 0.015), and AMP (99.0% versus 87.5%; P = 0.018). On the other hand, no antibiotic resistance pattern was observed among non-MDR *E. coli* strains for the rest of antibiotics.

Table 2
Rates of antibiotic resistance among patients with MDR *E. coli* versus non-MDR *E. coli* UTIs.

Antibiotics	MDR *E. coli* isolates (n = 104)	Non-MDR *E. coli* isolates (n = 8)	P value
CTX	24 (23.1%)	0	-
CAZ	58 (55.8%)	1 (12.5%)	0.015
CTR	12 (11.5%)	0	-
CPD	43 (41.3%)	0	-
CPM	9 (8.7%)	0	-
CIP	1 (1.0%)	0	-
SXT	72 (69.0%)	0	-
TE	49 (47.0%)	0	-
C	61(58.7%)	0	-
AMP	103 (99.0%)	7 (87.5%)	0.018
NA	19 (18.3%)	0	-
GE	59 (56.7%)	0	-
AMC	47 (45.2%)	0	-

4. Discussion

The threat of antibiotic resistance becomes a prime public health issue in developing countries, notably Ethiopia. Thus, according to a finding, many factors are contributing to high rates of bacterial antibiotic resistance, such as misuse/overuse of antibiotics by healthcare professional and general public, inadequate surveillance systems due to lack of reliable microbiological techniques leading to inappropriate prescription of antibiotics[2,3].

Likewise, the present study also demonstrates the problem of antibiotic resistance in *E. coli* isolates. Specifically, it showed that high prevalence of MDR *E. coli* isolates identified from patients with UTI was 92.9% (95% confidence interval: 87.3%–97.7%). The rate of MDR *E. coli* demonstrated in this study was much higher than findings from developed countries[8-10], but comparable to published

data from low income countries[4,5,11,12]. However, few reports from developing countries documented lower prevalence of MDR *E. coli* as compared to this study[13-16]. We hypothesized, the variation could be due to difference in geographical location, study period, study population and employed standard methods for each study.

Many of research findings revealed that antibiotic resistance becomes increased in alarming pace with function of time[2,17,18]. For instance, according to report from Gondar in 2002, the prevalence of MDR *E. coli* was 65.4%[19]. However, in our study the situation becomes escalated to 92.9%. Besides, with reference to previous reports, *E. coli* isolates were found to be highly resistant to commonly prescribed antibiotics, such as AMP, cotrimoxazole, C, GEN, and CTZ[8,20-23], which shows an agreement with the results reported in this study. Therefore, these antibiotics should not be recommended as a first line to treat UTIs. On the other hand, CIP demonstrated a high level of *in vitro* susceptibility, which are in line with other findings[11,15,19,24], and could be considered as drugs of preference to treat bacterial uropathogens.

In conclusion, high rates of antibiotic resistance were observed among *E. coli* isolates for commonly prescribed antibiotics. Moreover, high numbers of MDR *E. coli* isolates gave rise to concern. Regular monitoring of antimicrobial drug resistance seems necessary to improve standard guidelines for empirical antibiotic therapy.

Conflict of interest statement

We declare that we have no conflict of interest.

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References

[1] Barber AE, Norton JP, Spivak AM, Mulvey MA. Urinary tract infections: current and emerging management strategies. *Clin Infect Dis* 2013; **57**(5): 719-24.

[2] Sosa AJ, Byarugaba DK, Amabile C, Hsueh PR, Kariuki S, Okeke IN. *Antimicrobial resistance in developing countries*. New York: Springer; 2010.

[3] World Health Organization. Antimicrobial resistance. Geneva: World Health Organization; 2015. [Online] Available from: http://www.who.int/mediacentre/factsheets/fs194/en/ [Accessed on 25th, Novmber, 2015]

[4] Ibrahim ME, Bilal NE, Hamid ME. Increased multi-drug resistant *Escherichia coli* from hospitals in Khartoum state, Sudan. *Afr Health Sci* 2012; **12**(3): 368-75.

[5] Sabir S, Ahmad Anjum A, Ijaz T, Asad Ali M, Ur Rehman Khan M, Nawaz M. Isolation and antibiotic susceptibility of *E. coli* from urinary tract infections in a tertiary care hospital. *Pak J Med Sci* 2014; **30**(2): 389-92.

[6] Chesbrougn M. *Manual of medical microbiology*. Britain: Oxford Press; 2000.

[7] Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing: twenty-first informational supplement. Wayne: Clinical and Laboratory Standards Institute; 2012. [Online] Available from: http://antimicrobianos.com.ar/ATB/wp-content/uploads/2012/11/M100S22E.pdf [Accessed on 25th, Novmber, 2015]

[8] Santo E, Salvador MM, Marin JM. Multidrug-resistant urinary tract isolates of *Escherichia coli* from Ribeirao Preto, Sao Paulo, Brazil. *Braz J Infect Dis* 2007; **11**(6): 575-8.

[9] Khawcharoenporn T, Vasoo S, Singh K. Urinary tract infections due to multidrug-resistant enterobacteriaceae: prevalence and risk factors in a Chicago emergency department. *Emerg Med Int* 2013; **2013**: 258517.

[10] Sahm DF, Thornsberry C, Mayfield DC, Jones ME, Karlowsky JA. Multidrug-resistant urinary tract isolates of *Escherichia coli*: prevalence and patient demographics in the United States in 2000. *Antimicrob Agents Chemother* 2001; **45**(5): 1402-6.

[11] Alemu A, Dagnew M, Alem M, Gizachew M. Uropathogenic bacterial isolates and their antimicrobial susceptibility patterns among HIV/AIDS patients attending Gondar University specialized hospital Gondar, Northwest Ethiopia. *J Microbiol Res Rev* 2013; **1**(4): 42-51.

[12] Sharma AR, Bhatta DR, Shrestha J, Banjara MR. Antimicrobial susceptibility pattern of *Escherichia coli* isolated from uninary tract infected patients attending Bir Hospital. *Nepal J Sci Technol* 2013; **14**(1): 177-84.

[13] Baral P, Neupane S, Marasini BP, Ghimire KR, Lekhak B, Shrestha B. High prevalence of multidrug resistance in bacterial uropathogens from Kathmandu, Nepal. *BMC Res Notes* 2012; **5**: 38.

[14] Laghari AH, Shah AM. Multiple drug resistant (MDR) strains of *Escherichia coli* isolated from urinary tract infection, a predictor of female childhood protein deficiency in Southern Sindh, Pakistan. *Pak J Nutr* 2012; **11**(1): 47-50.

[15] Iqbal M, Patel IK, Shah SH, Ain Q, Barney N, Kiani Q, et al. Susceptibility patterns of *Escherichia coli*: prevalence of multidrug-resistant isolates and extended spectrum beta-lactamase phenotype. *J Pak Med Assoc* 2002; **52**: 407-11.

[16] Mehta M, Bhardwaj S, Sharma J. Prevalence and antibiotic susceptibility pattern of multi-drug resistant *Escherichia coli* isolates from urinary tract infection (UTI) patients. *Int J Life Pharm Res* 2012; **2**: 6-11.

[17] D'Agata EM. Rapidly rising prevalence of nosocomial multidrug-resistant, Gram-negative bacilli: a 9-year surveillance study. *Infect Control Hosp Epidemiol* 2004; **25**(10): 842-6.

[18] Dromigny JA, Nabeth P, Juergens-Behr A, Perrier-Gros-Claude JD. Risk factors for antibiotic-resistant *Escherichia coli* isolated from community-acquired urinary tract infections in Dakar, Senegal. *J Antimicrob Chemother* 2005; **56**(1): 236-9.

[19] Moges F, Mengistu G, Genetu A. Multiple drug resistance in Urinary pathogens at Gondar College of Medical science hospital, Ethiopia. *East Afr Med J* 2002; **79**(8): 415-20.

[20] Yismaw G, Asrat D, Woldeamanuel Y, Unakal CG. Urinary tract infection: bacterial etiologies, drug resistance profile and associated risk factors in diabetic patients. *Eur J Exp Biol* 2012; **2**(4): 889-98.

[21] Tiruneh M, Yifru S, Gizachew M, Molla K, Belyhun Y, Moges F, et al. Changing trends in prevalence and antibiotics resistance of uropathogens in patients attending the Gondar University Hospital, Northwest Ethiopia. *Int J Bacteriol* 2014; **2014**: 629424 .

[22] Gizachew M, Kebede M, Merid Y, Sinshaw Y, Tiruneh M, Alemayehu M, et al. *Escherichia coli* isolated from patients suspected for urinary tract infections in Hawassa Referral Hospital, Southern Ethiopia: an institution based cross sectional study. *J Microbiol Res* 2013; **1**: 9-15.

[23] Farshad S, Ranjbar R, Anvarinejad M, Shahidi MA, Hosseini M. Emergence of multi drug resistant strains of *Eschetichia coli* isolated from urinary tract infection. *Open Conf Proc J* 2010; **1**: 192-6.

[24] Kibret M, Abera B. Antimicrobial susceptibility patterns of *E. coli* from clinical sources in Northeast Ethiopia. *Afr Health Sci* 2011; **11**: S40-5.