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Microbiological profile and antimicrobial susceptibility pattern among patients with urinary tract infection in northern Tanzania

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Abstract

Background: Urinary tract infection (UTI) is the most common bacterial infection, it causes morbidity as well as financial burden. There is a role of empirical treatment of UTI while awaiting urine culture and sensitivity result. The type of empirical antibiotics given varies from place to place depending on susceptibility pattern of the particular area. According to Tanzania standard treatment guidelines and essential medicine list of 2013, cystitis in adult is treated by ciprofloxacin while pregnant women and children are treated by amoxicillin/clavulanate. In case of pyelonephritis, women of reproductive age who does not require referral are treated by ciprofloxacin while all other cases that fulfill criteria for referral are given single dose of ceftriaxone before referral. However, most studies have shown increasing resistance to commonly used antibiotics as a result of misuse and overuse.

The study aimed at describing the microbiological profile and susceptibility pattern among patients with UTI at KCMC.

Methods: This was a seven-month hospital based descriptive, cross-sectional study conducted from June 2016 to December 2016 by using structured data extraction sheet. Data analysis was performed using SPSS after cleaning and checking for error(s).

Results: A total of 270 samples that tested positive for UTI were analyzed. Majority 233(86.3%) of the sample were obtained from male subjects, age of study subjects ranged from 1-94 years with the median of 64 years. Majority 235 (87%) of the sample came from urology department with E. coli being most common cause of UTI (39.3%), followed by Klebsiella spp, 20%. E. coli demonstrated high sensitivity against amikacin, ceftazidime and Nitrofurantoin

Conclusion: The commonest cause of UTI in our set up is E. coli that showed high resistance against most commonly used antibiotics in our setting.

Keywords: Urinary tract infection; Kilimanjaro Christian Medical Center; Microbiological Profile; Antimicrobial susceptibility pattern.

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1. Introduction

Urinary tract infections (UTIs) are the most prevalent bacterial infection rendering people in the community and in hospitals to morbidity and financial burden in healthcare seeking [1,2].

It is approximated about 150-250 million people per annum are identified to have UTI worldwide [1,3]. Furthermore, it is estimated that the global visits to outpatient clinics to be as many as 7 million visits, emergency department 1 million and 100, 000 hospitalization annually [1,3,4]. The commonest causative organism of UTI is *Escherichia coli.* Others include *Staphylococcus aureus, Proteus mirabilis, Klebsiella spp., Enterococcus faecalis, Proteus vulgaris, Pseudomonas aeruginosa, Enterobacter spp., Staphylococcus epidermidis, and Providencia spp* [5]. The investigations for UTI include urinalysis and urine culture and sensitivity as the gold standard [6,7].

There is a role of empirical treatment while awaiting urine culture and sensitivity result. The type of empirical antibiotics given varies from place to place depending on microbiological profile and their sensitivity pattern. According to the European Association of Urology (EAU) guidelines of 2013, the recommended baseline drugs for UTI treatment are trimethoprim sulfamethoxazole, nitrofurantoin, trometamol, fosfomycin and pivmecillinam [5]. As per Tanzania standard treatment guidelines and essential medicine list of 2013, cystitis in adult is treated by ciprofloxacin, pregnant women and children are treated by amoxicillin/clavulanate. In case of pyelonephritis, women of reproductive age who does not require referral are treated by ciprofloxacin while all other cases that fulfill criteria for referral are given single dose of ceftriaxone before referral.

The World Health Organization (WHO) reported an increase in antimicrobial resistance across many different infectious agents, UTI being one of them [9]. The commonly used antibiotics are facing high rate of resistance. Globally, antimicrobial resistance is a life threatening condition, and it increases the treatment cost [3,10]. The cause of the resistance may be due to misuse and overuse of the antimicrobial. It can also occur naturally overtime due to genetic changes and the presence of drug resistant microbes in people, food, animals and hospital environments that spread either from person to person or between people and animals [9]. Microbiological profile and its susceptibility pattern should be known in every region to guide empirical treatment whenever needed [3,10]. The aim of the study is to describe the microbiological profile and antimicrobial sensitivity pattern among patients with UTI in our hospital.

2. Patients and Methods

This hospital based descriptive, cross-sectional study was carried out from June 2016 to December 2016 at KCMC, Moshi Tanzania. This zonal referral hospital in Northern zone of Tanzania has more than 600 bed capacity in a catchment area of approximately 15.7 million people. It has a large clinical laboratory that runs a number of tests including urine culture and sensitivity. The laboratory participates in external quality assurance with public health agency of Canada (QASI-LI), is also internationally recognized and accredited with ISO number15189.

The study evaluated all urine samples submitted to our lab during the study period and tested positive for UTI. Urine sample that grew multiple bacterial and the culture result form that were incomplete filled were excluded from the study. A structured questionnaire was used to collect data from clinical laboratory computer system.

Ethical clearance and permission was obtained from Kilimanjaro Christian Medical University College and clinical laboratory department at KCMC zonal referral Hospital. All patients' information was kept confidential; no patient's direct identifiers were used in the data extraction instrument. Data were entered into computer for analysis where by SPSS version 16 was used to analyze the information. Cross-tabulations were generated and comparisons were made.

3. Results

A total of 270 urine culture positive results were reviewed. The age range of the patients was 1-94 years with the median age of 64 years. Majority of patients were in the age group of 51- 75 years, 127(47.0%), followed by the age group of >75 years, 70(25.9%). The age group of 5 -25 had the frequency of 13(4.8%). Under-fives (<5 years) were the fewest, accounted for (3.3%). Males accounted for (86.3%) with urology department having the largest number of sample (Table 1).

Table 1 Socio-demographic characteristics (N=270)

Variable	Frequency	Percentage
	N	%
Subjects		
Age (years)		
<5	9	3.3
5-25	13	4.8
26-50	51	18.9
51-75	127	47
>75	70	25.9
Median age=64		
Sex		
Male	233	86.3
Female	37	13.7
Departments		
Urology	235	87
GOPD	3	1.1
Casualty	10	3.7
OG	1	0.4
Pediatrics	2	0.7
Medical	9	3.3
General surgery	8	3
RDTC	1	0.4
Orthopaedics	1	0.4

Eleven different types of bacterial pathogens were isolated with *E. coli* being the most prevalent (39.3%), followed by *Klebsiella* spp (20%). *Morganella spp* and *Serratia spp* were the least prevalent accounted for 1.9 and 1.1% respectively (Table 2).

Table 2 Different uropathogens isolated (N=270)

Uropathogens isolated	n (%)
E. Coli	106 (39.3)
Klebsiella pneumonia	54 (20)
Coliform	27 (10)
Pseudomonas aeruginosa	25 (9.3)
Citrobacter	17 (6.3)
Enterobacter	13 (4.8)
Proteus	10 (3.7)
Staphylococcus aureus	10 (3.7)
Morganella morganii	5 (1.9)
Serratia spp.	3 (1.1)
Total	270 (100)

E. coli has high sensitivity against amikacin (97%), and ceftazidime while demonstrating high resistance against ampicillin/clavulanate (87%), trimethoprim-Sulfamethoxazole (, 75%), ciprofloxacin (69%). *Klebsiella spp* were only 38% sensitive to cefotaxime and 36% sensitive to amikacin while demonstrating resistance against trimethoprim-sulfamethoxazole (100%), ampicillin/clavulanate (96%) and ceftazidime (70%) (Table 3 and 4). Table 3 Below summarizes the resistance profile of these drugs

Table 3 The pattern of drug resistance

			***Number of resistant sample n (%)**						
Uropathogens	**GEN**	**AMP**	**CET**	**SXT**	**CIP**	**AMK**	**CEZ**	**AMC**	**NIT**
E. Coli	48(56)	41(87)	28(47)	18(75)	62(69)	2(3)	7(27)	37(55)	33(42)
Klebsiella spp	35(69)	22(96)	20(63)	13(100)	32(67)	1(3)	7(70)	16(64)	27(68)
Coliform	14(58)	10(77)	2(14)	7(100)	13(65)	2(9)	1(13)	12(80)	19(83)
P. Aeruginosa	16(70)	4(100)	6(43)	4(100)	12(52)	4(21)	1(11)	7(88)	11(91)
Citrobacter	12(80)	10(100)	6(67)	3(75)	5(39)	0(0)	1(25)	5(56)	10(77)
Enterobacter spp.	4(67)	6(100)	1(50)	2(67)	10(83)	0(0)	0(0)	2(100)	4(67)
Proteus spp.	3(30)	4(67)	0(0)	2(100)	4(50)	1(14)	0(0)	3(75)	5(83)
S. Aureus	1(20)	1(25)	0(0)	0(0)	1(33)	0(0)	0(0)	0(0)	2(67)
Morganella spp.	0(0)	1(50)	1(33)	0(0)	2(50)	1(25)	1(50)	1(50)	1(33)
Serratia spp.	2(67)	0(0)	1(50)	0(0)	2(100)	1(33)	0(0)	0(0)	0(0)
TOTAL	135(59)	99(85)	66(46)	50(85)	143(64)	12(10)	18(31)	83(62)	112(60)
TOTAL	135(59)	99(85)	66(46)	50(85)	143(64)	12(10)	18(31)	83(62)	112(60)

*Resistance includes intermediate and resistance; Abbreviations: GEN, gentamicin; AMP, ampicillin; CET, cefotaxime; SXT, trimethoprim-sulfamethoxazole; CIP, ciprofloxacin; AMK, amikacin; CEZ, ceftazidime; AMC, amoxicillin/clavulanate and NIT, nitrofurantoin.

Table 4 Sensitivity profile of the isolates

			No of sensitive sample n (%)						
Uropathogens	**GEN**	**AMP**	**CET**	**SXT**	**CIP**	**AMK**	**CEZ**	**AMC**	**NIT**
E. Coli	38(44)	3(13)	32(53)	6(25)	28(31)	69(97)	19(73)	30(44)	45(57)
Klebsiella spp.	16(31)	1(4)	12(38)	0(0)	16(33)	1(4)	3(30)	9(36)	13(33)
Coliform	10(42)	3(23)	12(86)	0(0)	7(35)	21(91)	7(88)	3(20)	4(17)
P. Aeruginosa	7(30)	0(0)	8(57)	0(00)	11(48)	15(79)	8(89)	1(13)	1(8)
Citrobacter	3(20)	0(0)	3(33)	1(25)	8(62)	13(100)	3(75)	4(44)	3(23)
Enterobacter spp.	2(33)	0(0)	1(50)	1(33)	2(17)	6(100)	0(0)	0(0)	2(33)
Proteus spp.	7(70)	2(33)	6(100)	0(0)	4(50)	6(86)	0(0)	1(25)	1(17)
S. Aureus	4(80)	3(75)	3(100)	0(0)	2(67)	0(0)	0(0)	2(100)	1(33)
Morganella spp.	5(100)	1(50)	2(67)	1(50)	2(50)	3(75)	0(0)	1(50)	2(67)
Serratia spp.	1(33)	2(100)	0(0)	0(0)	0(0)	2(67)	0(0)	1(100)	3(100)

Abbreviations: GEN, gentamicin; AMP, ampicillin; CET, cefotaxime; SXT, trimethoprim-sulfamethoxazole, CIP, ciprofloxacin; AMK, amikacin; CEZ, ceftazidime; AMC, amoxicillin/clavulanate and NIT, nitrofurantoin

4. Discussion

Majority of urine sample analysed came from male subjects (86.3%) with the most prevalent (47%) age group being 51-75 years. This is different from other studies where by female are mostly affected [11,12]. The difference is due to the fact that majority of analysed sample in our study came from urology department (87%), in which more males are affected by urological condition than females. Moreover, males of this age group are more prone to UTI probably because they have prostate enlargement causing resistance to the flow of urine.

E. coli was the most prominent uropathogen isolated in 39.3% of the urine culture. This finding concurs with other studies in Tanzania and abroad though the figure is a bit lower [11,13,14]. Other frequently cultured uropathogens were *Klebsiella spp* (20%), *Pseudomonas spp*. (9.3%) and *Citrobacter Spp* (6.3%). This is different from other studies though the second most common uropathogens is the same [11,13]. This difference could be due to difference in geographical location, study population and sample size.

Most of isolated uropathogens showed high overall resistance against ampicillin, trimethoprim- sulfamethoxazole, ciprofloxacin and amoxicillin/clavulanate. *E. coli* were 87%, 75% and 69% resistant to ampicillin, trimethoprim-sulfamethoxazole and ciprofloxacin respectively. *Klebsiella Spp* were 96%, 100%, 67% and 64% resistant to ampicillin, trimethoprim- sulfamethoxazole, ciprofloxacin and amoxicillin/clavulanate respectively. Our finding is partly similar to other study that was done in another tertiary hospital in Tanzania that found high resistance against ampicillin, trimethoprim-sulfamethoxazole and amoxicillin/clavulanate [15]. In the index study, resistance against ciprofloxacin was higher compared to the previous study. The high resistance against these antibiotics is because they are the most common antibiotics used in the primary health facility but also they are accessed easily in the pharmacies even without doctor's prescription. In addition to that, high resistance to trimethoprim- sulfamethoxazole can be due to the fact that it has been in use for a long time for long-term prevention of Pneumocystis Jiroveci Pneumonia (PJP) in HIV positive patients. The difference observed between the index and previous study is due to the fact that in the latter study most of their participants were pediatric patient that usually are not treated by ciprofloxacin because of its side effects.

E. coli showed resistance of 42% against nitrofurantoin. This figure is much higher than other studies [16,17]. Our high resistance of 68% against nitrofurantoin amongst *Klebsiella Spp* isolates differs also from other studies in east Africa [18].

Resistance against gentamycin was high; for example, *E. coli* and *Klebsiella* Spp were 56% and 69% resistance against gentamicin respectively. This is much higher than what was reported in Dar es Salaam Tanzania by other investigator, where *E. coli* and *Klebsiella were* 38.4% and 28.8% resistant against gentamycin respectively [15]. The difference could be due to small sample size in our study and hence small number of isolates tested for gentamycin leading into overestimation.

Our finding of low resistance to amikacin is comparable to other study in the country and abroad [13,15,19]. The low resistance in our country is because this drug is not commonly used, hence less chance of microbes to develop resistance against it.

The antimicrobial sensitivity patterns vary from different geographical locations. In this index study, *E. coli* showed high rate of sensitivity to amikacin, ceftazidime and Nitrofurantoin; the sensitivity was 2 to 3 times lower to cefotaxime, amoxicillin/clavulanate, gentamicin, ciprofloxacin, trimethoprim-sulfamethoxazole and ampicillin. This is similar to the study done in Italy in which the sensitivity of *E. coli* to amikacin was high followed by third generation cephalosporin (ceftazidime and cefotaxime) and amoxicillin/clavulanate [20], however trimethoprim-sulfamethoxazole and ciprofloxacin showed some deviation in which it was among the least sensitive in our study [20].

In this study *Klebsiella spp*. had the highest sensitivity to amikacin that was 2 times lower compared to the study done in Italy but the sensitivity to the third generation cephalosporin and amoxicillin/clavulanate is almost similar [20].

Limitations of the study

The result of this study should be discussed in the light of the following limitation; this study was conducted in single centered zonal referral hospital and therefore the result cannot be generalized to all health facilities, but to the health facility with similar context.

Despite this limitation, our findings remained comparable to many other studies.

5. Conclusion

About two in five of bacterial isolates causing UTI is *E. Coli*. The resistance is high against most commonly used antibiotics; ampicillin, trimethoprim- sulfamethoxazole, ciprofloxacin and amoxicillin/clavulanate. *E. coli* had a high sensitivity against amikacin, ceftazidime and Nitrofurantoin, there fore we recommend use of these antibiotics whenever empirical treatment for UTI is required. In this study most urine sample came from urology department, therefore a prospective study is recommended for urological patients with UTI in order to find out the possible cause of UTI and their susceptibility profile. Since this was a single centered study, generalizability is limited, therefore a large multicenter study is recommended.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors listed in this article declare that they have no conflict of interest for this publication.

Statement of ethical approval

The ethical clearance was obtained for Kilimanjaro Christian Medical university ethical review committee.

Statement of informed consent

This study involved already collected and analyzed urine samples, therefore, informed consent was not required and hence not obtained.

References

[1] Fasugba O, Gardner A, Mitchell BG, Mnatzaganian G. Ciprofloxacin resistance in community and hospital-acquired Escherichia coli urinary tract infections. BMC Infectious Diseases. 2015; 1-16.

[2] Pobiega M, Wojkowska-Mach J, Maciag J, Chmielarczyk A, Romaniszyn D, Pomorska-Wosolowska M et al. Virulence and Antibiotic Resistance of Pseudomonas aeruginosa Isolated from Patients with Urinary Tract Infections in Southern Poland. Chemotherapy. 2014; 253-260.

[3] Zowawi HM, Harris PN, Roberts MJ, Tambyah PA, Schembri MA, Pezzani MD et al.The emerging threat of multidrug-resistant Gram-negative bacteria in urology. Nature Reviews Urology. 2015; 12(10): 570–584.

[4] Mohan DG, Sarmah A, Hazarika NK. A study on microbiological profile of complicated Urinary Tract Infection (UTI) in a tertiary care hospital of NE region. International Journal of Medical and Health Research. 2016; 2(1): 47–50.

[5] Linhares I, Raposo T, Rodrigues A, Almeida A. 'Incidence and Diversity of Antimicrobial Multidrug Resistance Profiles of Uropathogenic Bacteria. BioMed Research International. 2015; 1-11.

[6] Walker BR, Colledge NR, Ralston SH, Penman ID. Davidson's Principles & Practice of Medicine. 22nd Edition. Edinburgh:Churchill Livingstone. 2021.

[7] Wagenlehner Fm, Weidner W, Naber Kg. Emergence Of Antibiotic Resistance Amongst Hospital-Acquired Urinary Tract Infections And Pharmacokinetic/Pharmacodynamic Considerations. J Hosp Infect. Jul 2005; 60(3): 191-200.

[8] Ministry of health and social welfare of Tanzania. Standard Treatment Guidelines and the National Essential Medicine List [internet]. May 2013.

[9] WHO. WHO's first global report on antibiotic resistance reveals serious, worldwide threat to public health. 2014.

[10] Al-Benwan K, Al-Sweih N, Rotimi VO. Etiology and Antibiotic Susceptibility Patterns of Community- and Hospital-Acquired Urinary Tract Infections in a General Hospital in Kuwait. Medical Principles and Practice. 2010; 19(6): 440–6.

[11] Kalal B, Nagaraj S. Urinary tract infections: a retrospective, descriptive study of causative organisms and antimicrobial pattern of samples received for culture, from a tertiary care setting. GERMS. Dec 2016; 6(4): 132–138.

[12] Abejew AA, Denboba AA, Mekonnen AG. Prevalence and antibiotic resistance pattern of urinary tract bacterial infections in Dessie area, North-East Ethiopia. BMC research notes. December 2014; 1-7.

[13] Fredrick F, Francis JM, Fataki M, Maselle SY. Aetiology, antimicrobial susceptibility and predictors of urinary tract infection among febrile under-fives at Muhimbili National Hospital, Dar es Salaam-Tanzania. African Journal of Microbiology Research. 2013; 7(12): 1029-34.

[14] Linsenmeyer K, Strymish J. Two Simple Rules for Improving the Accuracy of Empiric Treatment of Multidrug-Resistant Urinary Tract Infections. Antimicrobial Agents and Chemotherapy. Dec 2015; 59(12): 7593–96.

[15] Moyo SJ, Aboud S, Kasubi M, Lyamuya EF, Maselle SY. Antimicrobial resistance among producers and non-producers of extended spectrum betalactamases in urinary isolates at a tertiary Hospital in Tanzania. BMC Research Notes. 2010; 1-5.

[16] Bours PHA, Polak R, Hoepelman AIM, Delgado E, Jarquin A, Matute AJ. Increasing resistance in community-acquired urinary tract infections in Latin America, five years after the implementation of national therapeutic guidelines. international journal of infectious disease. September 2010; 14(9): 770-74.

[17] Pourakbari B, Ferdosian F, Mahmoudi S, Mostafa Teymuri M, Sabouni F, Heydari H et all. Increase resistant rates and ESBL production between E. coli isolates causing urinary tract infection in young patients from Iran. Braz J Microbiol. Apr-Jun 2012; 43(2): 766-69.

[18] Kyabaggu D, Ejobi F, Olila D. The sensitivities to first-line antibiotic therapy of the common urinary tract bacterial infections detected in urine samples at a hospital in metropolitan Kampala (Uganda). Afr Health Sci. Dec 2007; 7(4): 214–22.

[19] Somashekara SC, Deepalaxmi S, Jagannath N, Ramesh B, Laveesh MR, Govindadas D. Retrospective analysis of antibiotic resistance pattern to urinary pathogens in a Tertiary Care Hospital in South. Journal of Basic and Clinical Pharmacy. 2014; 5(4): 105–8.

[20] Coppo E, Barbieri R, Bottaro LC, Illiberi O, Piazzai P, Debbia E A et al. Local survelance study on etiology of community-and hospital-acquired urinary tract infections (UTI) and antimicrobial susceptibility of uropathogens. Microbiologia Medica. 2012; 27(1): 17–19.