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ANTIMICROBIAL SUSCEPTIBILITY PATTERNS OF URINARY BACTERIA AMONGST PAEDIATRIC PATIENTS AT THE NAIROBI HOSPITAL, KENYA
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L. N. NJAGI, S. ODERA and F. MUTUA

ABSTRACT

Objective: **To determine the antimicrobial susceptibility patterns of urinary tract infections in the paediatric age group at The Nairobi Hospital.**
***Design*: A retrospective cross-sectional descriptive study.**
***Setting*: The Nairobi Hospital records department.**
***Results*: A total of 31 organisms were isolated consisting of *Escherichia coli* (n=132; 44.3%), *Klebsiella species* (n=59; 17.8%), *Proteus species* (n=28; 9.4%), *Staphylococcus aureus* (n=14; 5.7%), *Pseudomonas species* (n=14; 4.7%) and *Enterococcus species* (n=12; 4%). Others were less frequently isolated making up a total of 14.1%. Girls were more affected than boys with a ratio 6:4. Amongst the *E.coli* and *Klebsilla* isolates which were the most commonly isolated, resistance was high to commonly used antimicrobials such as trimethoprim/sulfamethoxazole (75%-80%) and amoxicillin clavulanate (50%). There was no statistical significance in the difference in the organisms isolated (p=0.775) or their susceptibilities to tested antimicrobials, between inpatients and outpatients.**
***Conclusion*: The change in the susceptibility patterns of the isolated organisms to the most commonly used antimicrobials points to a need for revision of the current guidelines, prudent use of antibiotics and regular surveillance of uropathogens and antimicrobial susceptibility patterns on a larger scale.**

INTRODUCTION

Urinary tract infections (UTIs) affect all age groups for both hospitalised and non-hospitalised individuals. In children, prevalence rates of as high as 26% have been documented in South Africa (1), with higher rates (up to 35%) in malnourished children (2). They are one of the most common hospital-acquired infections (HAIs), with hospitals forming the perfect breeding place for antibiotic resistance (3). Diagnosis of a UTI may be difficult because young children often present with non-specific symptoms such as fever, poor oral intake, vomiting or irritability. Unlike adults, children may easily develop pyelonephritis, renal scarring and hypertension secondary to an acute infection (4). Prompt identification and treatment of a first or recurrent infection plays an important role in the prevention of sequelae.

Initiation of an empiric antibiotic is based on the most likely pathogen and adjusted based on urine culture and susceptibility results. Several bacterial pathogens have been implicated as causative agents of UTIs. Gram-negative organisms are frequently associated with UTIs in children in developing countries, with *Escherichia coli* being the most common just as in adults, causing 60-90% of infections (1,2,4,5,7). This is followed by *Klebsiella spp* and *Proteus spp* (4). *Klebsiella spp* tends to occur more as a hospital acquired infection together with *Pseudomonas aeruginosa* (5). Other *Enterobacteriaceae* including *Salmonella spp, Enterobacter, Citrobacter* and *Morganella* are often isolated at a lesser frequency.

Several studies done in developing countries have demonstrated increasing resistance by most bacterial pathogens to many commonly used antibiotics (1-4, 6-8, 10). In Bangui, Central African Republic (CAR) for example, extended-spectrum beta-lactamase (ESBL) producing *Enterobacteriaceae*

significantly increased from 3.7% to 19.3% between 2004 and 2006. A significantly increased resistance rate to nalidixic acid, ciprofloxacin and gentamicin was observed in ESBL-nonproducing *Enterobacteriaceae* over the study period6. Although there is paucity of data on sensitivity patterns in our local setup, this is the likely trend as demonstrated by studies on *E. coli* as a cause of UTIs locally (8, 10).

In comparing differences between hospitalised and non-hospitalised patients, Urassa *et al* in 1997 concluded that there was no difference in susceptibility patterns of isolates from the two groups (11). In contrast Dada-Adegbola HO *et al* in 2010 concluded that isolates from the community showed higher susceptibility to tested drugs. He also found widespread resistance to most antibiotics including cephalosporins and quinolones among all uropathogens (12).

Studies in other countries have shown trimethoprim/sulphamethoxazole to be highly resisted by most organisms (13, 14). This is a drug recommended as a first line in the guidelines (15). A recent study in Kenya showed that greater than 75% of *E.coli* were susceptible to amoxicillin clavulanate (8), comparing to a study done in Dar es salaam with *E.coli* and *Klebsiella* showing very high susceptibilities to amoxicillin clavulanate (16).

Diagnosis of UTI is based on culture of a properly collected specimen of urine. However in most instances, it is either not possible to wait for the culture report, or laboratory facilities are unavailable or unreliable in some of the rural facilities. With growing antimicrobial drug resistance in Kenya, reliance on the international guidelines to allow an empiric approach to management of UTIs is insufficient, and hence local surveillance is imperative to get our local patterns, and hence formulate local policies.

This study therefore aimed to assess the current status of antimicrobial resistance among bacterial uropathogen isolates in the paediatric age group. In addition this research will open doors for further research, to compare results obtained to those of similar cases in government referral hospitals, to determine applicability in different settings in Kenya.

MATERIALS AND METHODS

Study design: This study was carried out at the Nairobi Hospital, a private sector city hospital in Kenya. This was a retrospective cross-sectional descriptive study, involving review of medical records from children, both male and female, inpatient and outpatient, below the age of 12 years clinically diagnosed with Urinary Tract Infections and confirmed by conventional culture methods, in the period July 2009 to June 2011. Concurrent information on pyuria was collected and analysed from all the cases to identify organisms that were contaminants.

Stratified randomised sampling was used. The sampling frame included all cases and was divided into three age strata, 0 to 11 months, one to six years and seven to twelve years. All cases not eligible were excluded and this included those with incomplete records, complicated cases as deduced from the case notes and those with more than two organisms isolated. A total of 298 culture positive cases were identified for analysis.

Ethical consideration: Ethical approval was obtained from Kenyatta National Hospital/The University of Nairobi Ethics and Research committee, as well as the Medical Advisory Committee at The Nairobi Hospital, the area of study. Confidentiality was maintained as the information was shared only between the assistant, the in charge of record keeping in the institute, and the principal investigator.

Data management and statistical analysis plans: Data were collected and entered on to a password protected tally sheet. These were data from laboratory reports, and case files were used to confirm the demographic data as well as exclude any case of complicated UTI. Data checking was done by double entry in the same sitting by the PI and the assistant. Data were collected was then coded. Analysis was done quantitatively using SPSS Version 17. Data analysed were summarised/presented using descriptive statistics. To determine the association between organisms isolated with their antimicrobial sensitivity patterns between hospitalised and non hospitalised cases, Chi-square test was used. Statistical tests were considered significant at a p-value of 0.05 with a 95% confidence).

RESULTS

For the twenty-four months of the study period, a total of 327 urine samples from children below 12 years of age were culture positive. Of these, 5% (n=15) of the cases had incomplete records, eight (n=2%) were complicated UTIs as deduced from the case notes and six (1.8%) had mixed growth hence were excluded from the study. Of the eight that were excluded as complicated cases three had anatomic abnormalities, three were diagnosed as pyelonephritis and two had UTI following catheterisation. This left 298 cases that were all included for the study.

UTI distribution amongst the cases demonstrated that females presented the highest prevalence of the cases (59.1%) compared to males at 40.1%. The age distribution of the study subjects were: below one year 12.8% (n=38), one to six years 59.8% (n=177) and seven to twelve years 27.9% (n=83). As per the hospitalisation status, 79.2% (n=236) of the cases had been managed as outpatient while 20.8% (n=62) had been managed as inpatient.

The most common clinical presentation of UTI in this cohort was fever and vomiting, with 75 % (n=224) of the patients presenting with fever of at least two days. Vomiting was present in 35% (n=75) of those below six years of age and 17% (n=14) of those above six years of age. Those who presented with both fever and vomiting accounted for 22% (n=66), and 20 % (n=59) presented with dysuria, 16.7 % (n=50) of whom were above six years of age and 3% (n=9) in the four to six years bracket. Other clinical presentation was irritability, refusal to feed and abdominal pain.

The most commonly prescribed antibiotics in these children were amoxicillin clavulanate at 45.9% followed by cefuroxime at 30%, then other cephalosporins.

Urinary tract pathogens isolated: A total of 31 different bacterial agents were identified from the 298 urine samples that were culture positive. Pyuria was present in 69.7% (n=207) of the patients where culture was positive. *Escherichia coli* was the most commonly isolated organism at 44.3 % (n=132), with 84% of the patients in whom *E.coli* was isolated having pyuria. *Klebsiella spp* seconded at 17.8 % (n=59), with *Klebsiella pneumoniae* consisting of 16.4 % (n= 49) and *K.oxytoca* 1.4 % (n=4). A total of 82% of the patients in whom *Klebsiella spp* was isolated had pyuria. Third in frequency was *Proteus spp* at 9.4 % (n=28), with *Proteus mirabilis* forming the majority at 5.7 % (n=17), *P.vulgaris* seconding at 3.7 % (n 11), and 85.7% of this patients having *pyuria*.

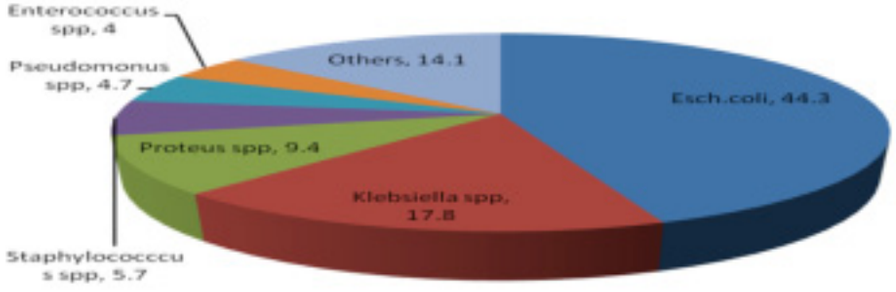
Staphylococcus spp was fourth in frequency consisting of 5.7% (n=17) distributed as follows; *Staphylococcus aureus* at 2.4% (n=7), *Staphylococcus* cohnii urealyticum at 0.3 % (n=1), *S.epidermidis* at 1.4% (n=4), *S.haemolyticus* at 0.7% (n=2), *S.saprophyticus* at 0.3% (n=1), *S.simulans* 0.3 % (n=1) and *S.warneri* 0.3% (n=1). Of the *staphylococcus spp*, *pyuria* was only present in 26% of the cases.

Pseudomonas spp was fifth in frequency at 4.7% (n=14) followed closely by *Enterococcus spp* at 4% (n=12), distributed as follows; *Pseudomonas aeruginosa* at 4.4% (n=13), *P.fluorescens* 0.3% (n=1), *Enterococcus faecalis* 3.7% (n=11) and *E. faecium* at 0.3% (n=1). Of the patients in whom *pseudomonas spp* was isolated 65% had *pyuria*, while those in whom *Enterococcus* was isolated only 18% had *pyuria*.

Others less frequently isolated all consisting of 14.1% most of which were contaminants were distributed as follows; *Acinectobacter baumannii* 2.4% (n=7), with 54.5% having *pyuria*, *Enterobacter cloacae* 2% (n=6), with 66.6% having *pyuria*, *Morganella morganii* 2% (n=6), with only 20% having *pyuria*, *Streptococcus agalactiae* 2% (n=6), only 16.6% having pyuria, *Citrobacter freundii* 1.3% (n=4), *Citrobacter koseri* 1% (n=3), *Citrobacter amalonaticus* 0.3% (n=1), only 37.5% of all *citrobacter spp* having *pyuria*, *Raoultella ornithinolytica* 1% (n=3), *Acinetobacter iwoffii* 0.7% (n=2), *Serratia marcescens* 0.3% (n=1), *Shigella boydii* 0.3% (n=1), *Sphingomonas paucimobilis* 0.3% (n=1), none having *pyuria* and *Yesinia enterocolitica* 0.3% (n=1),with *pyuria* an unusual occurrence given this was the sole isolate in this sample.

The distribution of the different agents discussed is shown in Figure 1.

Figure 1
Percentage of Organisms isolated



Distribution of organisms isolated, stratified by age: Overall UTIs was more common in the age group 1 year to six years regardless of the causative agent Table 1.

Below one year of age prevalence of *E.coli* and *Klebsiella spp* was equal, at 3.7% (n=11) and 3.4% (n=10) respectively, whereas for children above one year *E.coli* was the most prevalent at 29.1%(n=86) in children one year to six years and 11.8% (n=35) in children 7 years to 12 years (Table 1).

Overall, there was no difference in the organisms isolated from the different age groups (p=0.08). There was no statistical significance in the distribution of the four most commonly isolated organisms across the age groups: *E.coli* (p=0.102), *Klebsiella spp* (p=0.166), *Proteus spp* (p=0.07), and *Staphylococcus spp* (p=0.204). There was no significant difference in the distribution of isolated *E.coli* between those below one-year age group and the rest (p=0.052).

Table 1
Distribution of the different organisms stratified by age

Species	Below 1 year	1-6 years	7-12 years	p-value
E.coli	11(3.7%)	86(29.1%)	35(11.8%)	0.08
Klebsiella	10(3.4%)	28(9.5%)	11(3.7%)	
Proteus	2(<1%)	21(7.1%)	3(1%)	
Staphylococcus	4(1.4%)	7(2.4%)	6(2%)	
Enterococcus	2(<1%)	11(3.7%)	8(2.7%)	
Pseudomonas	1(<1%)	7(2.4%)	6(2%)	
Others	7(2.4%)	17(5.7%)	13(4.4%)	

Antimicrobial susceptibility of uropathogens isolated: Of the 132 *E.coli* isolates tested, only 18% (n=24) were susceptible to ampicillin, 55% (n=73) to amoxicillin-clavulanate, 19% (n=25) to trimethoprim / sulfamethoxazole and 18% (n=24) to piperacillin. Susceptibility to other tested antimicrobials was high, 91% (n=120) being susceptible to nitrofurantoin, 75% (n=99) to cefuroxime, 77% (n=102) to cefpodoxime, 82% (n=108) to cefotaxime, 88% (n=116) to ceftazidime, 99% (n=131)to cefepime, 88% (n=116) to gentamycin, 97% (n=128) to amikacin, 99% (n=131) to meropenem and 80% (n=106) to tobramycin.

Of the 49 *Klebsiella pneumoniae* isolates tested,only 2% (n=1) were susceptible to ampicillin, 25% (n=12) to trimethoprim / sulfamethoxazole, 31% (n=15) to piperacillin, 55% (n=27) to amoxicillin-clavulanate, 57% (n=28) to nitrofurantoin, 67% (n=33) to cefuroxime, and 69%(n=34) to cefpodoxime. The highest susceptibility was to cefotaxime at 73% (n=36) ceftazidime at 86% (n=42), cefoxitin at 90% (n=44), cefepime at 92% (n=45), gentamycin at 75% (n=37), amikacin at 94% (n=46), and meropenem at 96% (n=47).

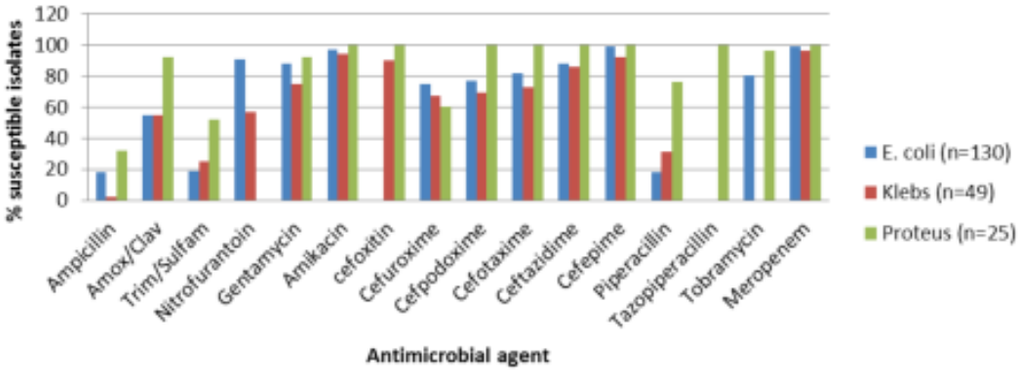
Of the 25 *Proteus spp* isolates tested, none were susceptible to nitrofurantoin, only 32% (n=8) were susceptible to ampicillin, 52% (n=13) were susceptible to trimethoprim / sulfamethoxazole, and 60% (n=15) to cefuroxime. Most of the other tested antimicrobials had high susceptibilities with 76% (n=19) being susceptible to piperacillin, 92% (n=23) to amoxicillin-clavulanate at, 92% (n=23) to gentamycin , 96% (n=24) to tobramycin and 100% (n=25) of the organisms being susceptible to cefoxitin, cefpodoxime, cefotaxime, ceftazidime, cefepime, amikacin, meropenem and tazopiperacillin.

The susceptibility patterns of the urinary pathogens is shown in Figure 2 below.

Seventeen isolates of *Staphylococcus* species were tested against various antimicrobials. Of these none were susceptible to ampicillin and penicillin, 53% (n=9) were susceptible to trimethoprim / sulfamethoxazole and oxacillin, 82% (n=14) to gentamycin and tobramycin,88% (n=15) to nitrofurantoin, 94% (n=16) to teicoplanin and vancomycin and 100% amoxicillin clavulanate and linezolid.

Figure 2

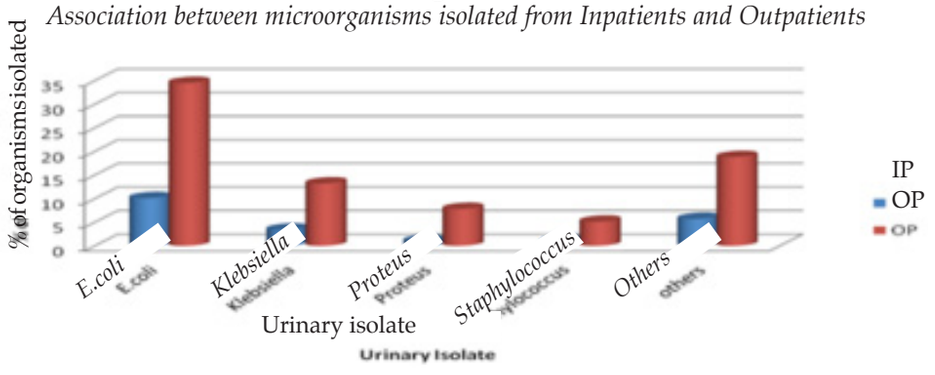
Susceptibility patterns of gram negative urinary isolates



Association between micro-organisms isolated and hospitalisation status: Of the 132 *E.coli* isolates 34.5% (n=102) of the total isolates were from the outpatient department while 10.1 % (n=30) of the total isolates were from the inpatient. Of the 49 *Klebsiella spp* isolates 13.2% (n=39) of the total isolates were from the outpatient while 3.4% (n=10) of the total isolates were from the inpatient. Of the 26 *proteus spp* isolates 7.8% (n=23) of the total isolates were from the outpatient while 1% (n=3) were from the inpatient department. Of the 17 *staphylococcus spp* isolated 5.1% (n=15) of the total isolates were from the outpatient department while 1% (n=2) of the total isolates were from the inpatient department. Of the 72 other organisms isolated 18.6% (n=55) of the total isolates were from the outpatient while 5.7 %(n=17) were from the inpatient. Overall the differences in the organisms isolated from inpatients and outpatients was not statistically significant (p=0.775, range 0.217-0.919). The association is as illustrated in Figure 3 below.

Figure 3

Association between microorganisms isolated from Inpatients and Outpatients



Key: OP-Out Patient IP-In patient

Association between susceptibility to antimicrobials between out and in-patient: A total of sixteen different antimicrobials were included as illustrated in Table 2.

There was no difference between the susceptibilities of organisms isolated from the inpatient and outpatient cases to all tested antimicrobials (each of the respective p values >0.05).

Table 2

Association between susceptibility to antimicrobials between out and in-patient

Drug	Susceptibility	IP	OP	P-Value
Ampicillin (n=266)	R	45(16.9%)	176(66.2%)	>0.05
	S	11(4.1%)	34(12.8%)	
AmoxicillinClavulanate (n=261)	R	24(9.2%)	94(36%)	
	S	30(11.5%)	113(43.3%)	
Amikacin (n=256)	R	2(<1%)	12(4.7%)	
	S	51(19.9%)	191(74.6%)	
Ceftazidime (n=256)	R	8(3.1%)	26(10.2%)	
	S	45(17.6%)	177(69.1%)	
Cefpodoxime (n=257)	R	14(5.4%)	60(23.3%)	
	S	40(15.6%)	143(55.6%)	
Cefotaxime (n=258)	R	11(4.3%)	50(19.4%)	
	S	43(16.7%)	154(59.7%)	
Cefuroxime (n=256)	R	16(6.3%)	76(29.7%)	
	S	37(14.5%)	127(49.6%)	
Cefepime (n=258)	R	3(1.2%)	11(4.3%)	
	S	51(19.8%)	193(74.8%)	

Cefoxitin(n= 258)	R	8(3.1%)	38(14.7%)
	S	46(17.8%)	166(64.3%)
Nitrofurantoin (=287)	R	15(5.2%)	79(27.5%)
	S	45(15.7%)	148(51.6%)
Gentamycin (n=275)	R	7(2.5%)	38(13.8%)
	S	49(17.8%)	181(65.8%)
Meropenem (n=205)	R	2(<1%)	9(3.5%)
	S	51(19.9%)	194(75.8%)
Oxacillin (n=17)	R	1(5.9%)	7(41.2%)
	S	1(5.9%)	8(47.1%)
Penicillin (n=20)	R	2(10.0%)	14(70.0%)
	S	1(5.0%)	3(15.0%)
Piperacillin (n=255)	R	38(14.9%)	129(50.6%)
	S	14(5.5%)	74(29.0%)
Trimethoprim/sulfamethoxazole	R	39(13.4%)	160(55.0%)
(n=291)	S	21(7.2%)	71(24.4%)

Key: OP-Out Patient IP-In patient

DISCUSSION

Urinary tract infection (UTI) is one of the most common bacterial infections seen in children. The definitive diagnosis of UTI in young children requires semi-quantitative culture of urine obtained by suprapubic aspiration or catheterisation. Microscopy for pyuria or positive leucocyte test on dipstick is a very important rapid diagnostic method for UTI, especially where previous empirical therapy has failed and culture may not grow, or in children where the standard method of urine collection as mentioned above is not followed. Injudicious use of antimicrobial agents has resulted in most gram positive and gram negative bacteria continuously developing resistance to the antimicrobials in regular use.

The aim of this study was to evaluate susceptibility patterns of bacterial strains isolated from UTIs in children at the Nairobi Hospital, Kenya. It provides valuable laboratory data concerning pathogens responsible for UTI in children and enables the situation at The Nairobi Hospital, Kenya to be compared with that in other settings and countries. This study focuses on cases from uncomplicated UTIs, excluding any case of complicated UTI.

It has been estimated that UTI are diagnosed in 1% of boys and 3-5% of girls (4). In this study UTIs were found to be more prevalent in girls than boys, with the majority of the cases, 59.8% (n=177) in the age group one to six years and the least, 12.8% (n=38) in those below one year of age. The largest group comprised of the outpatient at 79.1% (n=236). Although no data has been found to substantiate a higher prevalence in the age group one to six years, incidence has been found to be higher in girls as compared to boys after the first year of life (8, 12, 16). In girls, the first UTI usually occurs by the age of five years, with peaks during infancy and toilet training, while for boys most UTIs are in the first year and thereafter decline (4). This, with the fact that the female urethra is shorter, explains the higher incidence in girls the age of one to six years.

This study indicates that *E. coli* is still the most common cause of uncomplicated UTI at the Nairobi hospital, followed by *Klebsiella spp*, *Proteus spp* ,*Staphylococcus spp*, *Pseudomonas spp* and *Enterococcus spp* in that order. This is in keeping with findings from other studies and literature where *E.coli* is shown to be the most common organism causing UTI followed by *Klebsiella* and *Proteus spp* (1, 2, 4, 5, 7-9). *K.pneumoniae* was the most frequently isolated in the species, *Proteus mirabilis* most frequent amongst the *Proteus species* and *S. aureus* most frequent amongst the *Staphylococcus spp*. There was no significant difference in the distribution of species between age groups in keeping with other studies (6). There was no association between hospitalisation status and the organisms isolated.

Pyuria was found in 69.7% (n=298) of all the culture positive samples. In most of the cases where *E.coli*, *Klebsiella spp*, *Proteus spp* and *Pseudomonas spp* were isolated, *pyuria* was present indicating they were not contaminants. A small fraction of subjects where *Acinectobacter spp*, *Citrobacter spp*, *Enterococcus spp*, *streptococcus spp* and *staphylococcus spp* were isolated had *pyuria*, while a large number were contaminants. Most of the other organisms named were contaminants. *Yersinia enterocolitica*, as much

as it is not a primary cause of UTI, in this study was demonstrated to be a cause in one subject where there was a high pyuria. Since we had no control on how the samples were collected in this study, concurrent information on presence or absence of pyuria was therefore necessary, and demonstrates that the most commonly isolated organisms were not contaminants.

Most *E. coli* and *Klebsiella spp* isolates from uncomplicated infections investigated in this study were susceptible to oral drugs used in general practice such as nitrofurantoin, cefuroxime axetil, amoxicillin clavulanate, cefpodoxime, and gentamicin. However resistance was noted to be high to commonly used drugs such as trimethoprim/sulphamethoxazole, penicillin and ampicillin, which are some of the recommended first line drugs in the recent guidelines (15). Half of the *E.coli* and *Klebsiella* isolates were found to be resistant to amoxicillin clavulanate (figure 2). Given this is a drug frequently used in the outpatient department for treatment of UTIs in both children and adults, it is advisable that it is prescribed after susceptibility testing and not empirically. This is also putting into consideration that these were the two most commonly isolated organisms. These results are in line with other studies done on a similar subject where amoxicillin clavulanate and amoxicillin were only slightly better than trimethoprim/sulphamethoxazole in the overall susceptibility to most gram negative organisms isolated (13,14). In these studies susceptibility of isolated organisms to trimethoprim/sulphamethoxazole was demonstrated to be low. Contrasting results are seen in a recent study done in Kenya where greater than 75% of *E.coli* isolates were susceptible to amoxicillin clavulanate, comparable to a previous study done in Dar es Salaam where both *E.coli* and *Klebsiella* isolates were highly susceptible to amoxicillin clavulanate (8,16).

Proteus species isolates were highly susceptible to most common oral and parenteral antimicrobials. However, unlike with *E.coli* and *Klebsiella* isolates, resistance to nitrofurantoin was 100%. This is in line with literature confirming that nitrofurantoin has no activity on proteus (13, 14). The isolates were highly susceptible to amoxicillin clavulanate at 92%, and 50% of the isolates were demonstrated to be susceptible to trimethoprim/sulphamethoxazole in line with a study done at Seychelles' Victoria hospital (17), but contrasting a study done in Nigeria where only 8% of the organisms were susceptible to trimethoprim/sulphamethoxazole (13). Of the *Proteus vulgaris* isolates, 90.9% (n=10) were susceptible to amoxicillin clavulanate, in keeping with results from a study done in a children's hospital in France (18).

Most isolates of *staphylococcal* species were susceptible to nitrofurantoin, amoxicillin clavulanate, gentamycin and many of the second and third generation cephalosporins, in keeping with results from previous similar studies (13, 18). Half the isolates were susceptible to trimethoprim/sulphamethoxazole and 100% were resistant to penicillin and ampicillin, contrasting results from a study in Nigeria where only 17% were susceptible to trimethoprim/sulphamethoxazole, and 55% were susceptible to amoxicilin (13). As much as 100% of the isolates were susceptible to amoxicillin clavulanate, 47% demonstrated resistance to oxacillin hence were defined as methicillin resistant *S.aureus* (MRSA) and reported as resistant to all beta lactams in accordance with the Clinical Standards Laboratory Institute (CLSI) guidelines (18). This left only 53% of the isolates being susceptible to amoxicillin clavulanate.

Overall most isolates demonstrated susceptibility to most commonly used drugs aside from ampicillin, penicillin, trimethoprim/sulphamethoxazole and piperacillin. This compares with results from similar studies where resistance to ampicillin and trimethoprim/sulphamethoxazole was reported to be greater than 30% hence use of trimethoprim/sulphamethoxazole precluded (13, 19). Penicillin especially the oral formulations are widely used and sometimes misused in our setup explaining their high resistance, coupled with the fact that organisms causing UTI are mostly gram negative to which penicillin use may not be appropriate.

Susceptibility to the second line drugs namely third and fourth generation cephalosporins and carbapenems was still high at 80% to 100%. There was no significant difference in the susceptibility patterns between hospitalised and non-hospitalised cases in line with a study done in Dar-es Salaam (16). This would be explained by the fact that the study involved uncomplicated cases hence chances were high that most of the organisms were community acquired as opposed to hospital acquired or chronic care cases which have been shown in other studies to be more resistant (12).

Surveillance of uropathogens and antimicrobial susceptibility patterns should be carried out on a regular basis considering the changing susceptibility patterns demonstrated in this study. A revision of the current treatment guidelines is recommended, as well as prudent use of antibiotics to reduce the incidence of drug resistance.

A prospective study with a larger sample size should be carried out to guide on suitable antibiotics for treatment of UTI in pediatric patients, as well as a comparative study to determine applicability of the obtained results in a lower socio economic setting.

Missing data on relevant aspects such as history of antibiotic use in the one month prior to being attended to in the setup had the potential to lead to false assumptions affecting the classification and could lead to a case mix with confounding in terms of resistance patters. By going through records we had no way of controlling for how the samples were collected or handled during collection and processing,

hence possibility of false positives.

This study assumed that all standard operating procedures had been adhered to. Any laboratory reports with mixed growth were not used for this study and for any report where two organisms had been isolated, only the first one was considered and the second labeled as a contaminant if not already labeled so. Concurrent information on pyuria was collected and analysed to help identify organisms that were contaminants (20). A retrospective study such as this is prone to selection bias and this was minimised by the fact that all eligible in the sampling frame were selected.

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