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ANTIMICROBIAL SENSITIVITY AND RESISTANCE PATTERN OF CHILDREN WITH URINARY TRACT INFECTION IN A PRIVATE HEALTH FACILITY IN RIVERS STATE, NIGERIA

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ABSTRACT

Background: Urinary tract infection is one of the commonest infections worldwide. Bacterial resistance is becoming more common because of the non-judicious use of antibiotics. If urinary tract infection is poorly treated, sepsis, renal scaring, hypertension and eventual chronic renal failure may result. Thus, prompt diagnosis and the judicious treatment with appropriate antibiotic therapy would reduce associated morbidity and mortality as well as prevent antibiotic resistance. **Methods:** A retrospective study was carried out over a year on all children (0-17years) with clinical suspicion of UTI. Relevant data was retrieved from the hospitals' Health Management System and analysed. **Results:** Of 412 children with clinically suspected urinary tract infection, 184 (44.7%) had positive urine culture. Females predominated 130 (70.7%) with Male: Female ratio of 1:2.4. Most were of age 5-9years, 85 (46.2%). Commonest symptoms were abdominal pain/discomfort 92 (50.8%), perineal itch/discharge 28 (15.5%), frequent micturition 25 (13.8%) and painful micturition 25 (13.8%). Commonest organisms isolated were *Staphylococcus aureus* 145 (78.8%), *Escherichia coli* 43 (23.4%) and *Klebsiella spp* 8 (4.3%). The most sensitive antibiotics were streptomycin (78.8%), ciprofloxacin (75.0%), gentamicin (68.5%) and ceftriaxone-tazobactam (68.5%) while the most resistant antibiotics were amoxicillin (46.0%), norfloxacin (43.2%) and ampicillin-cloxacillin (38.6%). **Conclusion:** Urinary tract infection is common among females and children aged 5-9years. Ciprofloxacin may be given empirically to children with suspected urinary tract infection while awaiting urine culture results. Routine sensitivity and resistance pattern of urinary tract infection pathogens against commonly used antibiotics in hospitals is therefore recommended.

KEYWORDS: Antimicrobials, Sensitivity, Resistance, Urinary Tract Infection.

INTRODUCTION

Urinary tract infection (UTI) refers to a spectrum of clinical conditions ranging from asymptomatic bacteriuria to severe kidney infection with associated sepsis.[1] It is one of the commonest bacterial infections worldwide affecting over 150 million people yearly.[1] Also it is one of the most common bacterial infections in children and one of the main reasons for fever with resultant antibiotic prescription.[2],[3] The incidence of UTI in children reportedly ranges from 0.7% in infants to 11 % in adolescent females.[1],[2] Amongst febrile children the prevalence of UTI has been reported as high as 36.7% in Port Harcourt.[4]

Urinary tract infection is defined as a significant growth of a single bacterial pathogen in urine ie at least 10^4 colony forming units (cfu) for catheter specimen, at least 10^5 for mid-stream clean catch urine or $5x10^4$ CFU and significant pyuria in a patient with fever or other clinical symptoms.[2],[5] Urinary tract infections are mainly caused by Gram-negative bacteria such as *Eschericia coli*, *Kliebsiella pneumonia* and *Proteus mirabilis.*[1],[2],[3],[4] Other organisms such as Gram-positive organisms like *Staphylococcus saprophyticus* and *Enterococcus faecalis* have also been implicated.[1],[2],[3],[4]

Clinical symptoms of UTIs commonly seen are urinary frequency, painful micturition, abdominal pains, back pains, urgency, dysuria and pyuria.[1] In younger children however, symptoms may be non-specific and include fever, irritability, poor suck and even jaundice in neonates.[3],[6] In addition, bacteriuria may also be apparently asymptomatic.[1] Thus, a high index of suspicion is often required to make a diagnosis of UTI. An accurate diagnosis should therefore be made by promptly examining the urine, analysing and culturing the sample to identify the pathogens and determining their sensitivity to antimicrobial agents.[3]

Guidelines recommend that empiric antibiotics should be commenced for sick children with suspected UTI and then later changed according to the sensitivity results for isolated uropathogens.[2],[7] The choice of empiric antibiotics should ideally be based on sensitivity patterns derived from local epidemiologic research.[2],[7]

The widespread use of antibiotics (especially broad spectrum antibiotics) without appropriate susceptibility testing has led to an increase in the occurrence of UTIs caused by drug resistant bacteria which makes treatment difficult.[1],[2],[4],[8] This problem of bacterial resistance is worsened by inappropriate use of antibiotic prophylaxis, self-medication, inadequate dosing and wrong duration of treatment.[1] Thus, treatment with appropriate antibiotics both for initial empiric treatment and for definitive treatment following susceptibility testing with preferably an antibiotic with the narrowest effective spectrum is essential for proper treatment of UTI and would also reduce the risk of bacterial resistance.[1],[2],[3],[9] Untreated or poorly treated UTI can result in renal abscesses, sepsis, renal scarring, hypertension, reduced renal function and chronic renal failure.[3],[4],[9],[10],[11] Therefore, prompt diagnosis and appropriate treatment is essential to reduce associated morbidity and mortality from UTIs.[3],[4],[10],[11]

There is a paucity of recent data on the microbial pattern and sensitivity pattern of UTI in children in this part of the country, to the best of our knowledge. This present study thus aims at determining the antimicrobial pattern, sensitivity and resistance of antibiotics among children with UTI in a private health facility in Port Harcourt, Rivers state, Nigeria.

METHODOLOGY

This was a retrospective study involving all children seen with clinical suspicion of UTI, in a private paediatric hospital in Port Harcourt, Rivers State, over a 1-year period (from 1st of January 2021 to 31st of December, 2021). Our study centre, a 38-bedded private hospital, is well-equipped with a neonatal unit, children's wards, radiology unit and medical laboratory with attached blood bank services. Age group seen was 0-17 years with an average monthly out-patient attendance rate of 1250-1500 children (both general and specialist cases) and an average monthly admission rate of 80-100 children per month. It's staff strength included 8 paediatricians, surgeons and other support staff including nurses, laboratory scientist and technicians.

Data of all children reviewed with clinical suspicion of UTI during the study period was retrieved from the Clinics and Admissions records of the hospitals' Health Management System. Information obtained included age, sex, clinical features, diagnosis, urine microscopy, culture and sensitivity results which included organisms isolated, sensitivity and resistance patterns of the isolated organisms. Children with incomplete clinical or laboratory data were excluded from the study.

For every suspected case of UTI, Patients and their parents were instructed on how to collect urine samples appropriately according to their ages in order to minimize probable contamination. Clean voided mid-stream urine samples were collected in children >2 years of age (or those who are toilet trained) and clean catch urine samples were collected for those less than 2 years. All urine samples were collected in sterile universal bottles and submitted within one hour to the microbiology laboratory of the hospital for urinalysis, microscopy, culture and sensitivity.

Significant pyuria was defined as the presence of pus cell > 5 per high power field (HPF) of urine.[4],[12] Urine samples were inoculated separately on Blood agar (Oxoid, UK) and MacConkey agar (Oxoid, UK) plates, and incubated aerobically for 24-48 hours. Colony counts of a single microorganism of $>10^5$ cfu/ml was diagnosed as bacteriuria thus indicating urinary tract infection.[1],[2],[3],[4],[5] The bacterial isolates were identified using colony morphological characteristics, gram stain reactions and biochemical tests using AP12OE kits. Antimicrobial sensitivity patterns were determined by the Agar disk diffusion standard method using Nutrient agar.[1],[4],[13]

The tested antimicrobials in this study were streptomycin, ciprofloxacin, gentamicin, ceftriaxone/tazobactam, levofloxacin, chloramphenicol, erythromycin, rifampicin, amoxicillin, ampicillin/cloxacillin, norfloxacin, piperacillin/tazobactam, perflacin, ceftriaxone, cotrimoxazole, amoxicillin/clavulanic acid, tarivid, cefixime, ampicillin, ampicillin/sulbactam, cephalexin, cefuroxime, azithromycin and sparfloxacin.

Children diagnosed with UTI were treated according to standard protocols on out-patient basis or as in-patients depending on the severity of the illness.

Data was recorded in an Excel spreadsheet and analysed using SPSS version 23. Results were presented as frequency, percentages, pie and bar charts. Test of association was done using Chi square (χ^2) test and Fishers' Exact test. Statistical significance was set at *P* value < .05 while results were reported as odds ratios at 95% confidence intervals.

RESULTS

Age and sex distribution of patients with urinary tract infection

Of 412 children with clinical suspicion of urinary tract infection and urine culture carried out, 184 (44.7%) had positive urine culture. Females predominated 130

(70.7%) with Male: Female ratio of 1:2.4. The age group most affected was 5-9 years, 85 (46.2%), Table 1.

Table I: Age and sex distribution of patients with urinary tract infection.

Variables (%)	Frequency, n=184
Sex	
Male	54 (29.3)
Female	130 (70.7)
Age (years)	
< 5	59 (32.1)
5-9	85 (46.2)
≥ 10	40 (21.7)

Symptoms in children with urinary tract infection

The commonest symptoms were abdominal pain/discomfort 92 (50.8%) followed by perineal itch/discharge 28 (15.5%), frequent micturition 25 (13.8%) and painful micturition 25 (13.8%), Figure 1.

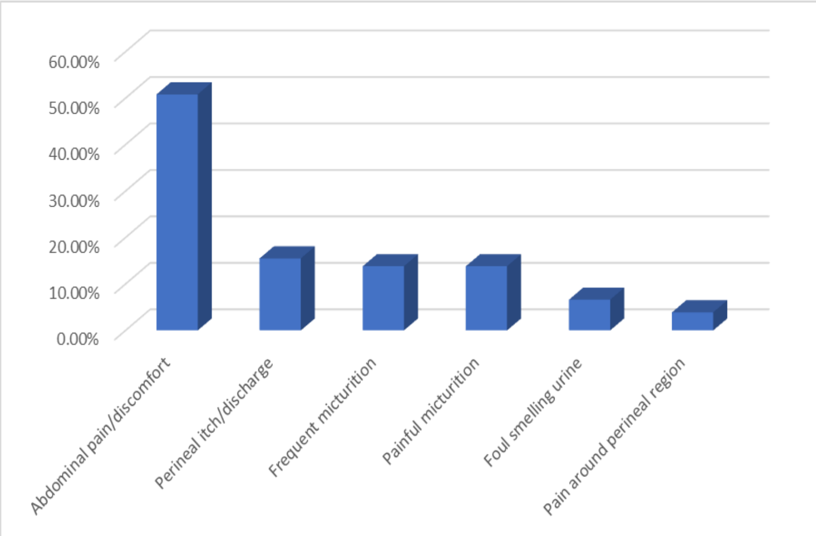

Figure 1: Symptoms in children with UTI.

Organisms Isolated in Children with UTI

The commonest organism isolated was *Staphylococcus aureus* 145 (78.8%) followed by *Escherichia coli* 43 (23.4%) and *Klebsiella spp* 8 (4.3%), Figure 2.

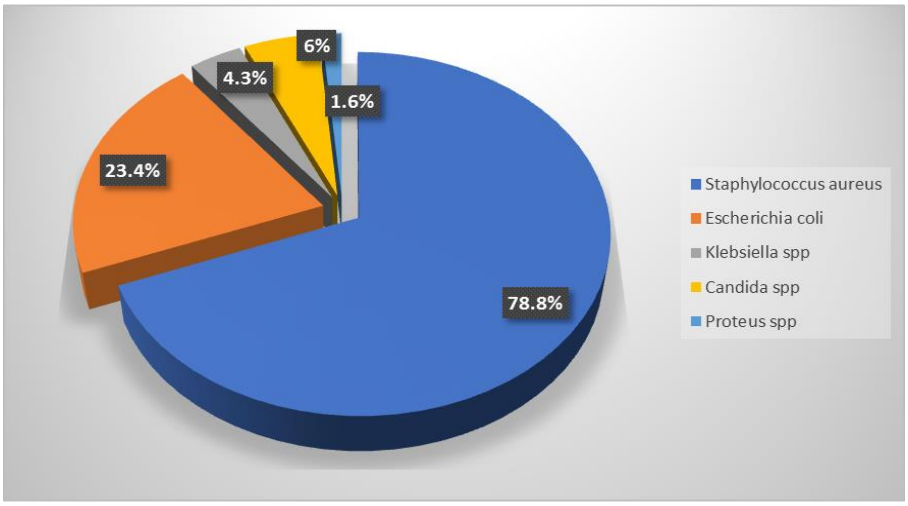

Figure 2: Organisms isolated in children with UTI.

Distribution of isolated organisms by sex and age

There was no significant association between the sex and age groups of children with the type of organisms isolated, $P > 0.05$, Table II.

Table II: Distribution of isolated organisms by sex and age.

Organisms	Sex			*P* value
	Male, n (%)	Female, n (%)		
Staphylococcus aureus	43 (79.6)	102 (78.5)		1.000
Escherichia coli	11 (20.4)	32 (24.6)		0.573
Klebsiella spp	1 (1.9)	7 (5.4)		0.440
Candida spp	1 (1.9)	10 (7.7)		0.972
Proteus spp	2 (3.7)	1 (0.8)		0.206
		Age (years)		
	< 5, n (%)	5-9, n (%)	≥ 10, n (%)	
Staphylococcus aureus	46 (78.0)	69 (81.2)	30 (75.0)	0.690
Escherichia coli	16 (27.1)	15 (17.6)	12 (30.0)	0.223
Klebsiella spp	3 (5.1)	5 (5.9)	0	0.332
Candida spp	3 (5.1)	4 (4.7)	4 (10.0)	0.890
Proteus spp	1 (1.7)	2 (2.4)	0	1.000

Antimicrobial Sensitivity Pattern

The commonest sensitive antibiotics were streptomycin (78.8%), Ciprofloxacin (75.0%), gentamicin (68.5%) and ceftriaxone/tazobactam (68.5%) while the least sensitive was cephalexin (4.3%), cefuroxime (4.3%), azithromycin (3.3%) and sparfloxacin (3.3%), Figure 3.

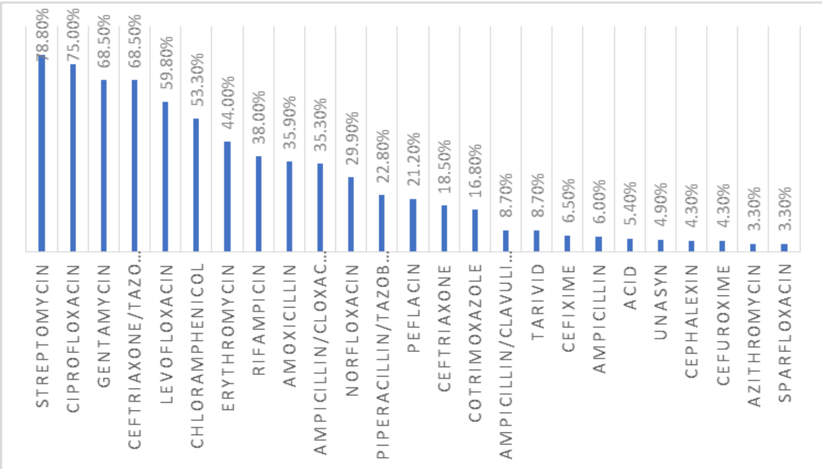

Figure 3: Antimicrobial sensitivity pattern.

Antimicrobial Resistance Pattern

The most resistant antibiotics were amoxicillin (46.0%), norfloxacin (43.2%), ampicillin-cloxacillin (38.6%) and erythromycin (34.1%) while the least resistant were cefpodoxime (2.3%), azithromycin (2.3%), levofloxacin (1.7%) and sparfloxacin (1.7%), Figure 4.

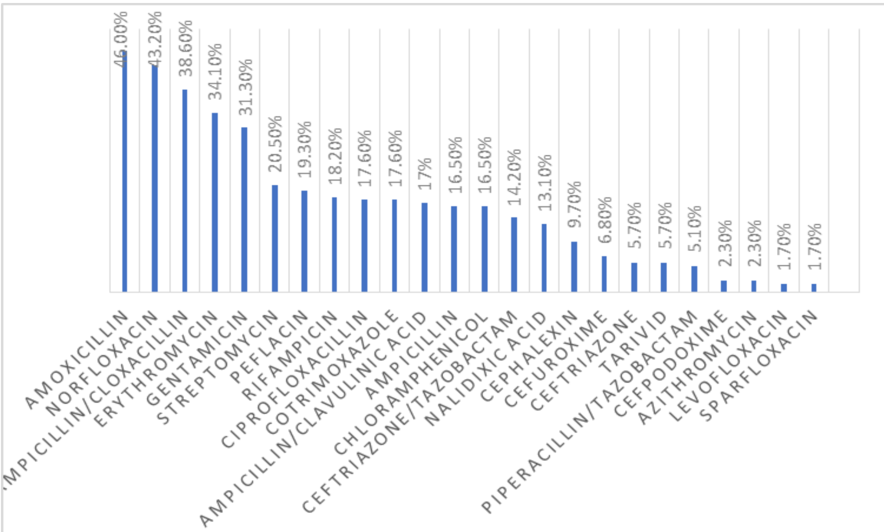

Figure 4: Antimicrobial resistant pattern.

Sensitivity and resistance pattern to commonly isolated organisms in children with UTI

Antibiotics most sensitive to *Staphylococcus aureus* were ciprofloxacin (79.3%), gentamicin (73.1%) and ceftriaxone/tazobactam (71.7%) while the most resistant were ampicillin/cloxacillin (57.2%), amoxicillin (52.4%) and erythromycin (37.2%).

Gentamicin (62.8%), ciprofloxacin (62.8%) and ceftriaxone/tazobactam (60.5%) were the most sensitive antibiotics to *Escherichia coli* while the most resistant were ampicillin (44.2%), norfloxacin (37.2%) and gentamicin (37.2%).

Ceftriaxone (50.0%) was the most sensitive antibiotic to *Klebsiella spp* while gentamicin (75.0%) was the most resistant, Table III.

Table III: Sensitivity and resistance pattern to commonly isolated organisms in children with UTI.

Antibiotics		*Staph aureus* (%)	*E. coli* (%)	*Klebsiella spp*(%
Amoxicillin	S	63 (43.4)	4 (9.3)	2 (25.0)
	R	76 (52.4)	14 (32.6)	3 (37.5)
Norfloxacin	S	3 (27.3)	14 (32.6)	3 (37.5)
	R	4 (36.4)	16 (37.2)	3 (37.5)
Ampicillin/cloxacillin	S	63 (43.4)	4 (9.3)	1 (12.5)
	R	62 (57.2)	8 (18.6)	3 (37.5)
Erythromycin	S	77 (53.1)	7 (16.3)	1 (12.5)
	R	54 (37.2)	10 (23.3)	3 (37.5)
Gentamicin	S	106 (73.1)	27 (62.8)	2 (25.0)
	R	37 (25.5)	16 (37.2)	6 (75.0)
Ciprofloxacin	S	115 (79.3)	27 (62.8)	5 (62.5)
	R	21 (14.5)	7 (16.3)	3 (37.5)
Cotrimoxazole	S	23 (15.9)	6 (14.0)	2 (25.0)
	R	13 (9.0)	15 (34.9)	3 (37.5)
Amoxicillin/clavulanate	S	5 (3.4)	12 (27.9)	0
	R	10 (6.4)	15 (34.9)	4 (50.0)
Ampicillin	S	2 (1.4)	9 (20.9)	0
	R	12 (8.3)	19 (44.2)	3 (37.5)
Ceftriaxone/Tazobactam	S	104 (71.7)	26 (60.5)	0
	R	17 (11.7)	12 (27.9)	0
Nalidixic acid	S	0	10 (23.3)	0
	R	5(3.5)	14 (32.6)	3 (37.5)
Cephalexin	S	3 (2.1)	5 (11.6)	0
	R	2 (1.4)	12(27.9)	3 (37.5)
Ceftriaxone	S	24 (16.6)	5 (11.6)	4 (50.0)
	R	10 (6.9)	0	0
Cefixime	S	16 (11.0)	3 (7.0)	1 (12.5)
	R	12 (8.3)	0	0

E= Echerichia, Staph= Staphylococcus, Spp = Specie

Association of antimicrobial sensitivity pattern and isolated organisms

Ciprofloxacin was sensitive significantly to infection of the urinary tract caused by *Escherichia coli* (*P* = 0.044) and *Staphylococcus aureus* (*P* = 0.013) while gentamicin was sensitive significantly to *Klebsiella spp* (*P* = 0.013) and *Staphylococcus aureus* (*P* = 0.012). Ampicillin/sulbactam was sensitive significantly to *Proteus spp* (*P* = 0.030) and *Klebsiella spp* (*P* <0.001). Levofloxacin was sensitive significantly to *Escherichia coli* (*P* = 0.003) and *Staphylococcus aureus* (*P* <0.001), Table IV.

Table IV: Association of antimicrobial sensitivity pattern and isolated organisms.

Organisms Isolated value	Streptomycin			Ciprofloxacin		
	Yes, n(%)	No, n(%)	P value	Yes, n(%)	No, n(%)	*P*
Proteus spp	2 (1.4)	1 (2.6)	0.513	3 (2.2)	0	0.574
Escherichia coli	36 (24.8)	7 (17.9)	0.523	27 (19.6)	16(34.8)	**0.044***
Klebsiella spp	8 (5.5)	0	0.206	5 (3.6)	3 (6.5)	0.415
Staph aureus	110 (75.9)	36(89.7)	0.077	115 (83.3)	30 (65.2)	**0.013***
Genticin				**Ampicillin/sulbactam**		
Proteus spp	2 (1.6)	1 (1.7)	1.000	0	3 (5.2)	**0.030***

Escherichia coli	27 (21.4)	16 (27.5)	0.356	26 (20.6)	17 (29.3)	0.260
Klebsiella spp	2 (1.6)	6 (10.3)	**0.013***	0	8 (13.8)	**<0.001***
Staph aureus	106 (84.1)	39 (67.2)	**0.012***	104 (82.5)	41 (70.7)	0.081
Levofloxacin						
Proteus spp	3 (2.7)	0	0.275			
Escherichia coli	17 (15.5)	26 (35.1)	**0.003***			
Klebsiella spp	3 (2.7)	5 (6.8)	0.271			
Staph aureus	101 (91.8)	44 (59.5)	**<0.001***			

*= Statistically significant, Staph = Staphylococcus, Spp= specie

Association of antimicrobial resistance and isolated organisms

Amoxicillin and norfloxacin were resistant significantly to *Staphylococcus aureus* (*P* <0.001) while ampicillin/cloxacillin was resistant significantly to *Escherichia coli* (*P* = 0.004) and *Staphylococcus aureus* (*P* = 0.001). Erythromycin was resistant significantly to *Staphylococcus aureus* (*P* = 0.012) whereas gentamicin was resistant significantly to *Klebsiella spp* (*P* = 0.010) and *Staphylococcus aureus* (*P* =0.018), Table V.

Table V: Association of antimicrobial resistance and isolated organisms.

Organisms	Streptomycin			Ciprofloxacin		
Isolated	**Yes, n(%)**	**No, n(%)**	**P value**	**Yes, n(%)**	**No, n(%)**	***P* value**
Proteus spp	2 (1.4)	1 (2.6)	0.513	3 (2.2)	0	0.574
Escherichia coli	36 (24.8)	7 (17.9)	0.523	27 (19.6)	16(34.8)	**0.044***
Klebsiella spp	8 (5.5)	0	0.206	5 (3.6)	3 (6.5)	0.415
Staph aureus	110 (75.9)	36(89.7)	0.077	115 (83.3)	30 (65.2)	**0.013***
	Genticin			**Ampicillin/sulbactam**		
Proteus spp	2 (1.6)	1 (1.7)	1.000	0	3 (5.2)	**0.030***
Escherichia coli	27 (21.4)	16 (27.5)	0.356	26 (20.6)	17 (29.3)	0.260
Klebsiella spp	2 (1.6)	6 (10.3)	**0.013***	0	8 (13.8)	**<0.001***
Staph aureus	106 (84.1)	39 (67.2)	**0.012***	104 (82.5)	41 (70.7)	0.081
	Levofloxacin					
Proteus spp	3 (2.7)	0	0.275			
Escherichia coli	17 (15.5)	26 (35.1)	**0.003***			
Klebsiella spp	3 (2.7)	5 (6.8)	0.271			
Staph aureus	101 (91.8)	44 (59.5)	**<0.001***			

*****Statistically significant. Spp- specie, Staph = Staphylococcus

DISCUSSION

Positive urine culture was documented in 44.7% of children with suspected UTI. This was comparable with the 52.5% reported in Cameroun[14] but lower than the 72.27% reported in India.[15] The high percentage of positive urine culture in the present study is in keeping with the fact that UTI is a common infection of the paediatric age group. Much lower percentages of 16.1%, 16%, 15.8%, 11% and 9% were documented in Iran,[16] Nepal,[17] Ethiopia,[18] and other parts of Nigeria[10],[19] respectively. These differences could be attributed to variations in methodology, difference in the sample sizes, age groups studied as well as varying geographic locations. In the prospective study carried out in Enugu,[10] children with chronic diseases, renal diseases, sickle cell anaemia, malignancies, HIV/AIDS were excluded unlike in the present retrospective study where these cases were not excluded. In addition, the very low positivity rate of 9% documented by Musa-Aisien et al[19] in Benin, southwest Nigeria could be because only febrile under- five children with or without a focus of infection were evaluated in contrast with the present study where all children 0-17 years with suspected UTI were evaluated.

Females predominated in the present study as observed by most other researchers.[10],[15],[16],[18],[20],[21],[22],[23],[24],[25],[26] This is not surprising as females have shorter urethra thus more predisposed to UTI than their male counterparts.[27] It is pertinent to note that the prevalence of UTI is higher in males in the 1st 3months of life because of a greater incidence of structural abnormalities then followed by female predominance after the 1st year of life.[28] This finding was in keeping with the study by Musa-Aisien et al[19] which documented a significantly higher prevalence of UTI in females than in males. In few studies however,[17],[29],[30] males predominated. The reason for this difference could not be ascertained as the age group studied in most of the researches were similar, being 0-15year olds.

Close to half (46.2%) of the study population with UTI were of age group 5-9 years in the present study. This was consistent with the findings by Abuhandan et al[21] in

Turkey who documented a mean age of 8.8 ± 3.6 years. Children < 5 years were reported as the commonest age group with UTI in another study in northern Nigeria[29] and India,[15],[24] whereas in Ethiopia,[18] children 11-15 years predominated. In addition, Ibeneme et al[10] in Enugu southeast Nigeria reported that UTI was significantly more in infants than in non-infants (*P* = 0.028). These varying age groups could be because of the variations in their methodology – with variations in the different age group being studied. In the Ethiopian study,[18] only children 5-15 years were evaluated whereas in the present study 0-17 year olds were evaluated.

Abdominal pain was the commonest symptom observed in the present study followed by urinary frequency and dysuria. Interestingly, Musa-Aisien et al[19] observed that abdominal pain was significantly associated with UTI. The finding of the present study was however at variance with the report by Nji et al,[14] who reported urinary frequency as the commonest symptom among children with UTI, followed by nocturia and incontinence. Fever was the commonest symptom documented by Shrestha et al[17] followed by dysuria and urgency while Gul et al[25] reported dysuria as the commonest symptom followed by flank pain and fever. These variations could be attributable to the varying age groups studied.

Staphylococcus aureus, a gram-positive organism was the commonest organism isolated in the urine culture of children with UTI in the present study followed by *Escherichia coli* and *Klebsiella spp*. *Staphylococcus spp* was also the commonest organism isolated in Awka,[31] southeast Nigeria but the 2nd commonest in other parts of Nigeria[10],[32],[33] Cameroun,[14] Iran,[16] and Nepal.[17] It is however pertinent to note that *Coagulase negative staphylococcus (CoNS) are* usually regarded as contaminants and not a true cause of bacteraemia whereas *Staphylococcus aureus* which was isolated in the present study is usually pathogenic with high morbidity and mortality. In the present study, children with renal diseases, malnutrition, HIV/AIDS, sickle cell anaemia and malignancies which could predispose them to *Staphylococcus aureus* infection were not excluded being a retrospective study thus may be responsible for the outcome observed. In the Enugu[10] study where *Staphylococcus aureus* was the 2nd commonest organism isolated, a sizeable number of these patients had nephrotic syndrome. In most other studies[14],[34],[35] however, *Escherichia coli*, a gram negative organism predominated. Other studies[32],[36] however, reported the predominance of *Klebsiella spp*. These variations could be attributable to varying geographic locations, methodologies including varying study designs and collection techniques of urine samples as well as variation of organisms over time even within the same locality. The present study was done retrospectively so the possibility that some of the study participants may not have adhered to the instructions given before collection of the urine samples cannot be ruled out completely.

In the present study, *Staphylococcus aureus* was seen more in males while *Escherichia coli* was seen more in females although this was not statistically significant. This was also documented by Bilkisu et al[29] in Gusau, northwest Nigeria. *Escherichia coli* being commoner in females was also documented in other studies.[10],[24],[37],[38] This could be as a result of the proximity of the female urethra to the anus which encourages contamination of the urethra especially when proper hygiene is lacking and the wrong practice of the female genitals being cleaned from the back forwards instead of the reverse.[38]

Ciprofloxacin was the most sensitive antibiotics to *Staphylococcus aureus* followed by gentamicin and ceftriaxone/tazobactam. This corroborates findings in the present study with ciprofloxacin and gentamicin being sensitive significantly to *Escherichia coli* and *Staphylococcus aureus* respectively. In Maiduguri,[39] *Staphylococcus aureus* was 100% sensitive to ciprofloxacin whereas Mekonnem et al,[40] in Ethiopia documented ciprofloxacin as the 2nd most sensitive antibiotics to *Staphylococcus aureus* with rifampicin being the most sensitive. Ciprofloxacin was also documented to have good sensitivities to isolated organisms from urine in other studies.[10],[33],[40] The high sensitivity of ciprofloxacin could be because it is sparingly used in the paediatric age group especially in the under-fives because of the purported side effects in children. It was initially thought that the fluoroquinolones such as ciprofloxacins had high risk of cartilage toxicity in immature animals and were therefore restricted in children.[41] It is however noteworthy that ciprofloxacin has been documented to be relatively safe in children as no arthropathy has been reported so far thus can be safely used for empiric treatment of children with UTI.[42] Gentamicin had also good sensitivity, probably because of its limited use by physicians because of its renal and ototoxic effects. In contrast, Nji et al[14] in Cameroun in their cross-sectional case control study of children 15 years and below with symptoms of UTI documented cotrimoxazole as the most sensitive antibiotics to *Staphylococcus aureus* followed by ceftriaxone and nitrofurantoin. These variations could be due to differences in the antibiotic prescription choices in the various geographic locations, varying standard operating procedures with varying 1st line of choice of drugs and policies regarding accessibility to antibiotics. Ceftriaxone was observed to be poorly sensitive in the present study which was contrary to the high sensitivity reported in another study in Enugu,[26] southeast Nigeria and Cameroun.[14] It is worthy of note that in the present study, amoxicillin and ampicillin/cloxacillin were the most resistant to *Staphylococcus aureus*. The present finding corroborates other studies in Turkey[21] where ampicillin/sulbactam, cefuroxime and cotrimoxazole were resistant and in Ethiopia[40] where ampicillin and tetracycline were mostly resistant. In the present study, amoxicillin was resistant significantly to *Staphylococcus aureus* while ampicillin/cloxacillin was resistant significantly to *Escherichia coli* and *Staphylococcus aureus.* These antibiotics are commonly prescribed as 1st line for both inpatients and out-patients in the treatment of infections generally and are thus susceptible to being abused by parents/caregivers especially in developing countries where prescription drugs including antibiotics can be easily obtained over the counter. In addition, the resistance pattern in the present study involved mainly drugs that were orally administered suggesting abuse as a possible cause. It is pertinent to note that drugs with high resistance should not be used for empirical treatment as it could lead to treatment failure, longer hospital stay, increased cost of treatment as well as increased morbidity and mortality. Hence, susceptibility testing should be carried out from time to time so as to identify resistant drugs and possible change of empiric antibiotics in patients with suspected bacterial infection. This will thus reduce morbidity and mortality arising from UTI as well as minimize the rates of drug resistance.

In the present study, ciprofloxacin, gentamicin and ceftriaxone were mostly sensitive to *Escherichia coli.* In Ethiopia,[18] Nigeria[26],[39],[43] and Iran[16] more than 70-80% of *Escherichia coli* were sensitive to ciprofloxacin also. Contrarily in Bahrain, Shaaban et al[20] documented nitrofurantoin, amikacin, piperacillin/tazobactam and gentamicin as most sensitive while in Cameroun, Nji et al[14] showed that cefadrol, nitrofurantoin and amoxicillin/clavulanic acid were most sensitive. In Ethiopia, Mekonnem et al[40] reported meropenem, amoxicillin and ciprofloxacin as mostly sensitive. It is noteworthy that these varying sensitivity pattern could be attributed to the varying empiric antibiotic prescription pattern in addition to the different geographic locations and variation over time.

Ampicillin, norfloxacin and amoxicillin were mostly resistant to *Escherichia coli* in the present study. In Bahrain,[20] cefazolin, ampicillin and ceftazidime were most resistant whereas ampicillin/sulbactam, amoxicillin/clavulinic acid and cotrimoxazole were reported in Turkey.[21] In Poland,[22] amoxicillin/clavulanic acid, cotrimoxazole and ciprofloxacin were documented, in Cameroun,[14] ampicillin and ceftriaxone were documented while ampicillin and tetracycline were reported in Ethiopia.[40] Interestingly, most of the drugs (ampicillin and amoxicillin) resistant to the isolated organisms in the present study are the commonly used medications for the treatment of common infections in children especially in Nigeria. This was also the case in other studies.[18],[34],[36],[44],[45] In addition, most of these drugs are oral, frequently prescribed, readily accessible, relatively affordable, readily available in patent medicine stores and thus easily abused by both physicians and caregivers. This therefore suggest that these drugs should no longer be used empirically in these centres for treatment of UTI. The sensitivity of ceftriaxone (18.5%) to isolated organisms were foreseeable as this drug in recent times had become 1st line in many centres in our locality. Thus, prolonged and indiscriminate use of drugs could also account for resistance. In addition, use of antibiotics without susceptibility data due to limited diagnostic facilities could also result in resistance. Hence, knowledge of the antibiotic susceptibility and resistance pattern from time to time is very important in the provision of effective treatment of children with suspected UTI. In contrast, reports in Maiduguri[39] and Benin[19] showed good sensitivity to ceftriaxone. These latter studies were done much earlier in contrast with findings with more recent findings from the present study.

CONCLUSION

Urinary tract infection is still common particularly among females and children aged 5-9years. Ciprofloxacin may be given empirically to children with suspected UTI while awaiting urine culture results.

We recommend routine sensitivity and resistance pattern of UTI pathogens against commonly used antibiotics in hospitals so as to effect changes if need-be for better management of children with UTI.

LIMITATIONS

This was a retrospective study thus there could have been high possibility of improper sample collection as not all the mothers may have adhered to the instructions given. There is also the possibility that some of the urine culture test may have been carried out despite prior antibiotics administration within 7 days, being a retrospective study. This may have contributed to the resistance pattern.

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