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Original Article

Etiologic Profile and Sensitivity Pattern of Germs Responsible for Urinary Tract Infection Among Under-five Children in Douala, Cameroon: A Hospital-Based Study

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Abstract

Background: Urinary tract infection (UTI) is considered as one of the most common diseases encountered in medical practice. This study aimed at determining the prevalence and antibiotic susceptibility of bacteria responsible for UTI among under five-year-old children.

Methods: A cross-sectional study was conducted at the Bonassama District Hospital of Douala, Cameroon. Sociodemographic and clinical information was documented, followed by collecting urine samples for bacteriological examination and antibiotic sensitivity test.

Results: The prevalence of UTI was 32.25% (129/400) and girls were more infected than boys (57.4% vs. 42.6, *P*=0.007). In addition, *Escherichia coli* (41.08%) and *Enterobacter cloacae* (18.6%) were the main bacteria which were isolated in this study and the resistance rates of *E. coli* isolates were higher for penicillin and second- and first-generation cephalosporins. This pattern was similar for *E. cloacae* and *Klebsiella pneumoniae* as well.

Conclusions: Overall, UTI is still a major public health problem in Cameroon.

Keywords: Uropathogens, Children, Prevalence, Antibiotic resistance

Background

Urinary tract infection (UTI) is usually defined as the presence of actively multiplying organisms in any part of the urinary tract such as kidneys, bladder, and urethra (1,2). Bacterial agents are mainly implicated as the causative germs of UTIs (3,4) which account for more than 95% of all cases (5). Viruses, parasites, and fungi may also be responsible for this type of infection, especially in immuno-compromised individuals (1,3). Each year, about 150 million urinary infection cases are recorded worldwide costing the world economy over six billion US dollars (5,6). According to some reports, several factors such as age, gender, race, and circumcision status are associated with an increased risk of UTI (1). The bulk of UTI-induced burden is concentrated on children, pregnant women, child-bearing women, and immunocompromised individuals (1,3).

Similarly, evidence-based information regarding the epidemiology of UTIs is increasingly released but disseminated in the African continent. However, the existing studies evaluating the prevalence of UTI causative germs emphasized the significant predominance of Gram-negative bacteria with *Escherichia coli*, *Staphylococcus aureus*, and *Klebsiella pneumoniae* as the most prevalent germs (7-10).

Young children represent one of the most social groups who are at the risk of UTI (1,3) which is a common and important public health problem since its symptoms in children may be subtle or non-specific making the diagnosis more complicated (11,12). In general, the symptoms in children may include fever, vomiting, diarrhoea, poor appetite, irritability, and the overall feeling of illness (4). When UTI is not early diagnosed, life-threatening complications such as sepsis and renal scarring may occur as a consequence. In addition, renal scarring is the most common cause of hypertension in later childhood and renal failure in adulthood (3,7,12).

In developing countries particularly in resource-constrained ones, the treatment of UTI heavily relies on an empiric or probabilistic approach (2,7,12) which owing to various reasons, may be initiated even before the availability of the final laboratory diagnostic test results (6). Accordingly, this increases the drug pressure which the uropathogens are exposed to and thus leads to the

emergence of drug-resistant and multidrug resistant germs. Drug resistance is increasingly growing in many parts of the world (13) and undermining different control endeavours in order to eliminate UTI as a public health problem, especially in children who pay the heaviest burden to these infections (1,3). Therefore, knowing about the patterns of UTI-related germs and their antibiotic sensitivity profile is extremely essential in medical practice to adequately define treatment policies.

Objectives

In Cameroon, there is a paucity of studies addressing these issues, especially about the children. Therefore, the current study sought to identify the prevalence of the causative pathogens of UTI and sensitivity patterns to commonly used antibiotics in children less than five years consulting at the Bonassama District Hospital in Douala, Cameroon.

Methods

Study Area

The study was performed at the Paediatrics Department of Bonassama District Hospital, which is a health facility located in the town of Douala, Cameroon.

Study Design and Sample Size

A descriptive and analytical cross-sectional survey was conducted from May 2013 to March 2014. The sample size was calculated using the Lorentz's formula as follows.

$n = Z^2p(1-p)/d^2$

where n and Z represent the required sample size and the statistic for the desired confidence level (1.96 for 95% confidence level). In addition, p and d denote the assumed prevalence of UTI among under-five children and the accepted margin of error (5%). The prevalence value of UTI (13.99%), found by Tchendjou Takam (14), was fitted in the formula as well. Thus, the effective sample size with this value was set at 185 individuals.

Study Population

The population of the study included children aged 0-59 months. All children attending the paediatric department with their parents and having a prescription for urine examination were included in the current study and consent was obtained from their parents while those children who had none of the aforementioned criteria were excluded from the study.

Data Collection

The strategy of urine sampling varied with regards to the age of the children and their ability to control the micturition. A child either under catheter or with difficulty in controlling their micturition was considered unable to urinate. To collect the urine from such children, suprapubic aspiration was performed for new-borns after cleaning the skin with alcohol antiseptic solution. Mid-stream clean catch urine (MSU) was obtained in all children who were able to provide MSU. Further, the sterile container was placed in children unable to control their micturition for 30 minutes. When no urine was sampled, a new sterile collector sac was placed for 30 minutes and continued until successful collection of urine specimen. Prior to urine sampling, children's genital organs were carefully cleaned with alcohol antiseptic solution. In catheterized children, urine specimens were collected by pressing the tube of the catheter for 30 minutes and then puncturing the accumulated urine upstream with a sterile syringe. The collected urine specimens were placed onto a tray on the same day of recruitment and immediately transported to the laboratory of the Paediatrics Department for analysis. In addition, information regarding gender, age, residence area, weight, and temperature were documented using an ad-hoc collection form.

Laboratory Procedures

Urinalysis

The urine samples were analysed macroscopically for colour and turbidity. Thereafter, they were centrifuged, the supernatant was discarded, and the deposits were examined under the microscope for the presence of white blood cells (pus cells), red blood cells, crystals, epithelial cells, parasites, and yeasts. The count of the forenamed elements was performed using Malassez cell. Furthermore, pH and the presence of nitrates, haemoglobin, proteins, and glucose were determined using urinary dipstick according to the manufacturer's instructions.

Isolation, Count and Identification of Bacteria Colonies

Ten microliters (10 µL) of each urine sample were inoculated onto the culture media using the calibrated platinum loop and then incubated at 37°C for 24-48 hours. Several culture media were used such as cysteine lactose electrolyte deficient agar, eosin-methylene blue (EMB), Muller Hinton agar, and Sabouraud dextrose agar (SDA). EMB was applied for identifying Enterobacteriaceae. Moreover, SDA was applied for determining yeasts and performing antifungigram while Muller-Hinton agar was used for performing antibiogram. The media were prepared in accordance with the manufacturer's recommendations and the results were reported in terms of the number of cells/high power field (HPF). High colony counts with more than one species of microorganisms were considered as contamination and the culture was repeated for contaminated plates. A culture plate was considered positive for UTI if the concentration of a single organism was $\geq 10^5$ CFU/mL. Finally, the isolates were identified by the examination of each pure bacterial colony using the API 20E kit and pyuria and haematuria were defined as the presence of more than five leukocytes or erythrocytes per HPF.

Antimicrobial Susceptibility Testing

The antimicrobial susceptibility of the isolates was tested by the disk diffusion method with respect to a standard method proposed by the National Committee for Clinical Laboratory Standards in 2013. Similarly, individual colonies were suspended to 0.5 McFarland using normal saline, followed by inoculating the suspensions on Muller-Hinton agar and incubating at 37°C for 18-24 hours. Twenty-six antimicrobial agents were tested as follows.

Amoxicillin (30 µg); amoxicillin + clavulanic acid (20/10 µg); penicillin g (2 µg); oxacillin (1 µg);cefazolin (30 µg); cefalotin (30 µg); cefamandole (30 µg); cefoxitin (30 µg); cefuroxime (30 µg); cefotaxime (30 µg); ceftriaxon (30 µg); ceftazidime (30 µg); netilmicin (30 µg); gentamicin (10 µg); tobramycin (10 µg); amikacin (30 µg); ofloxacin (5 µg); levofloxacin (5 µg); ciprofloxacin (5 µg); nalidixic acid (30 µg); erythromycin (2 µg); clarithromycin (15 µg); lincomycin (2 µg); vancomycin (30 µg); fusidic acid (10 µg); colistin sulfate (25 µg).

Statistical Analysis

Data were keyed and coded in an Excel sheet and the statistical analysis was performed using StatView software, version 5.0 (SAS Institute Inc., USA). Descriptive statistics were employed where appropriate. Eventually, the association between dependent and independent variables was tested using the independence chi-square test. Statistical significance was set at $P<0.05$.

Results

Baseline Data

In total, 400 children were included in the study. As shown in Table 1, boys were more represented (52.7%) when compared to their girl counterparts (47.3%) with a sex ratio (M/F) of 1.14. The mean age was 17 ± 14 months with 1 and 59 as the extreme values. The 6-12-month age group was the most prevalent (29%) and less than one child out of five (15%) had a previous history of antibiotics intake. As regards the signs and symptoms observed at clinical examination, 200 (50.0%) cases presented one clinical sign while only seven (1.8%) of them demonstrated no clinical symptom (Table 1). Additionally, fever (313 cases), cough (95 cases), vomiting (54 cases), and diarrhoea (42 cases) were the most frequent clinical signs and symptoms in children (Figure 1).

Table 1. Baseline Characteristics of the Children

Variables	Categories	Frequency/Value	%
Gender	Girls	189	47.3
	Boys	211	52.7
Age groups (mon)	(0-6)	66	16.4
	(6-12)	116	29.0
	(12-24)	105	26.3
	(24-60)	113	28.3
Mean age ± SD (month)		17 ± 14	
Mean temperature ± SD (°C)		37.8 ± 0.9	
Mean weight ± SD (kg)		8.8 ± 3.1	
Antibiotic intake history	No	344	86.0
	Yes	56	14.0
Urine collection method	Pot	298	74.5
	Collector Sac	102	25.5
Number of signs and symptoms presented	None	7	1.8
	One	200	50.0
	Two	139	34.8
	Three	52	13.0
	Four	2	0

Urinalysis

Based on the macroscopic analysis, 68.3% and 94.5% of urine specimens were yellowish and bright, respectively (Table 2). Interestingly, the microscope-based analysis revealed the presence of epithelial cells, yeast, crystals in 8.5%, 1.4%, and 0.4% of urine specimens, respectively. In addition, urinary dipstick-based testing highlighted some cases of glycosuria, proteinuria, and haematuria (Table 2).

Prevalence of Urinary Tract Infection and Causative Microbial Agents

The overall prevalence of UTI was 32.25%. Of the positive samples for UTI, *Escherichia coli* was the most isolated germs with 41.1% of all cases of infection, followed by *Enterobacter cloacae* (18.6%), *Klebsiella pneumoniae* (8.5%), and *Staphylococcus aureus* (6.9%). Three samples (2.2%) were positive for *Candida albicans* and the Gram-negative bacteria accounted for 90.9% of all the cases of UTI (Table 3).

Characteristics of Children Diagnosed With Urinary Tract Infection

As presented in Table 4, children diagnosed with UTIs were mainly girls (57.4%) and aged 6-12 months (36.4%) compared to those UTI-negative cases. Further, positive children were significantly younger than their negative counterparts (14.0 ± 13.1 years vs. 17.6 ± 14.2 years ($P=0.014$). Besides, the proportion of children having a history of antibiotics intake ($P=0.525$) and presenting

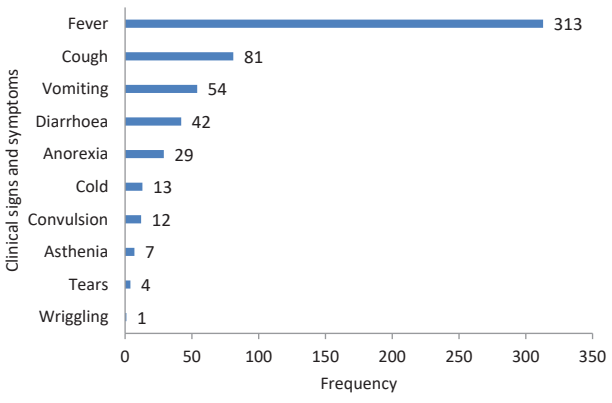

Figure 1. The Frequency of Clinical Signs and Symptoms

Table 2. Results from Urinalysis

Variables	Category	Frequency/ Value	Percent/Min-Max Values
Colour of urine	Yellowish	273	68.3
	Citrine yellow	117	29.3
	Amber-coloured yellow	5	1.2
	Pale yellow	5	1.2
Turbidity	Bright	378	94.5
	Cloudy	22	5.5
Presence of epithelial cells	No	366	91.5
	Yes	34	8.5
Mean epithelial cells count ± SD (/mm³)		4 ± 6	0 - 80
Presence of yeasts	No	395	98.6
	Yes	5	1.4
Mean yeasts count ± SD (/mm³)		1 ± 1	0 - 8
Presence of crystals	No	399	99.6
	Yes	1	0.4
Presence of cylinders, RBC or parasites	No	400	100
	Yes	0	0
Presence of leucocytes	No	345	86.3
	Yes	35	13.7
Mean leucocytes count ± SD (/mL)		4231 ± 6504	0 - 30500
Presence of nitrates	No	292	73.0
	Yes	108	27.0
Presence of cetonic bodies	No	398	99.5
	Yes	2	0.5
Glycosuria	No	397	99.3
	Yes	3	0.7
Proteinuria	No	395	98.8
	Yes	5	1.2
Haematuria	No	398	99.5
	Yes	2	0.5
Mean pH ± SD		6 ± 0.4	0 - 8.5

at least one sign/symptom at admission (P=0.087) were similar between positive and negative children (Table 4).

Antibiotic Sensitivity Testing

Overall, the resistance of bacteria found in this study was more emphasized (i.e., more than 50%) for four antibiotic classes (i.e., penicillins, along with the first, second, and third generation cephalosporins) as presented in Table 5. Indeed, *E. coli*, *E. cloacae*, and *K. pneumoniae* isolates were mainly resistant to amoxicillin with the resistance rates of 96.2%, 100%, and 100%, respectively. Similar rates regarding resistance to amoxicillin + clavulanic acid were also found for these three germs (i.e., 90.6%, 100%, and 90.9%, respectively). Likewise, the germs were resistant although less susceptible compared to penicillin class, to second and third generation cephalosporins. Furthermore, the highest rates of resistance were recorded against cefalotin and cefamandole which were 75.5% and 64.2% for *E. coli*, 87.5% and 75% for *E. cloacae*, along with 90.9% and 63.6% for *K. pneumoniae*. However, the lowest resistance rates were recorded for aminosids and quinolones families. On the other hand, *S. aureus* was most resistant to second and third generation cephalosporins with the overall rate of 77.8% for each antibiotic except for cefazolin (66.7%). Likewise, *S. aureus* was less resistant against aminosids and quinolones families (Table 5).

Table 3. The Prevalence of the Isolated Germs With Respect to Gram-Staining and Biological Group

Groups	Isolated germs	Frequency	Percent
Gram-negative bacteria (n = 117, 90.9%)	*Escherichia coli*	53	41.1
	Enterobacter cloacae	24	18.6
	Klebsiella pneumoniae	11	8.5
	Raoultella ornithinolytica	4	3.1
	Acinetobacter baumanii	3	2.2
	Serratia liquefaciens	3	2.2
	Erwina spp	2	1.6
	Klebsiella oxytoca	2	1.6
	Kluyvera spp	2	1.6
	Proteus mirabilis	2	1.6
	Providencia stuartii	2	1.6
	Salmonella spp	2	1.6
	Serratia odorifera	2	1.6
	Citrobacter koseri	1	0.8
	Enterobacter sakazakii	1	0.8
	klebsiella ozaenae	1	0.8
	Providencia rettgeri	1	0.8
	Steno maltophilia	1	0.8
Gram-positive bacteria (n = 9, 6.9%)	*Staphylococcus aureus*	9	6.9
Yeast (n = 3, 2.2%)	*Candida albicans*	3	2.2
	Total	**129**	**100**

Discussion

UTI is a serious public health problem, especially in Cameroon. This study was designed to determine the prevalence and sensitivity pattern of the causative uropathogens germs of UTI in children less than five years consulting at the Bonassama District Hospital of Douala.

The incidence of UTI was 32.5% in this study. This was higher as compared to the reports by Banapurmath and Jayamony (15), Rai et al (12), Farajnia et al (16), Msaki et al (17), Samuel et al. (10), and Khatoon et al. (2) in which it was estimated at 8%, 13.2%, 28.6%, 20.3%, 26%, and 17.8%, respectively. On the other hand, the prevalence of UTI was lower than that of the other studies (3,5,7-9,11). For instance, Festo et al (7) and Saeed et al (11) found 39.7% and 35% incidence rates, respectively. The differences in the study design, as well as the study population and sample size may explain these discrepancies. Moreover, this may be related to the geographical difference of the risk cofactors of UTI in population from this area such as nutritional status or poor life hygiene. Interestingly, this fact may probably explain the dynamic nature of UTI epidemiology over time and space as previously outlined by the other authors (16,18).

Table 4. Characteristics of Children Diagnosed With Urinary Tract Infection

Variables	Categories	UTI-Negative		UTI-Positive		*P* Value
		No.	%	No.	%	
Gender	Girls	117	43.2	74	57.4	0.007*
	Boys	154	56.8	55	42.6	
Age (months)	(0-6)	41	15.1	25	19.4	0.018*
	(6-12)	69	25.5	47	36.4	
	(12-24)	73	26.9	32	24.8	
	(24-60)	88	32.5	25	19.4	
Mean age (months)		17.6 ± 14.2		14.0 ± 13.1		0.014*
Mean temperature (°C)		37.7 ± 0.9		38.1 ± 0.9		0.000*
History of ATB treatment	No	231	85.2	113	87.6	0.525
	Yes	40	14.8	16	12.4	
Number of signs/symptoms	None	6	2.2	1	0.8	0.087
	One	128	47.2	72	55.7	
	Two	101	37.3	38	29.5	
	Three	36	13.3	16	12.4	
	Four	0	0.0	2	1.6	

UTI: Unitary tract infection; Data are presented as frequency (percentage) and mean ± standard deviation; The Chi-square test and one-way analysis of variance were used to compare proportions and means, respectively; * *P* value less than 0.05 (statistically significant).

Table 5. The Results of Antimicrobial Sensitivity Testing

Antibiotic classes	Nature of Antibiotics	*E. coli* (n = 53)	*E. cloacae* (n = 24)	*K. pneumoniae* (n = 11)	*S. aureus* (n= 9)
Penicillin	Amoxicillin	51 (96.2)	24 (100)	11 (100)	6 (66.7)
	Amoxicillin + clavulanic acid	48 (90.6)	24 (100)	10 (90.9)	6 (66.7)
	Oxacillin	-	-	-	3 (33.3)
	Penicillin G	-	-	-	3 (33.3)
First generation cephalosporin	Cefalotin	40 (75.5)	21 (87.5)	10 (90.9)	7 (77.8)
	Cefazolin	38 (71.7)	20 (86.9)	7 (63.6)	6 (66.7)
Second generation cephalosporin	Cefamandole	34 (64.2)	18 (75)	7 (63.6)	7 (77.8)
	Cefoxitin	30 (56.6)	18 (75)	6 (54.5)	7 (77.8)
	Cefuroxime	27 (50.9)	12 (50)	9 (81.8)	7 (77.8)
Third generation cephalosporin	Cefotaxime	23 (43.4)	11 (45.8)	6 (54.5)	7 (77.8)
	Ceftriaxone	18 (33.9)	8 (33.3)	6 (54.5)	7 (77.8)
	Ceftazidime	16 (30.2)	9 (37.5)	6 (54.5)	7 (77.8)
Aminosids	Netilmicin	6 (11.3)	2 (8.30)	0 (0)	2 (22.2)
	Gentamicin	10 (18.9)	0 (0)	0 (0)	2 (22.2)
	Tobramycin	9 (16.9)	2 (8.30)	2 (18.2)	4 (44.4)
	Amikacin	6 (11.3)	0 (0)	1 (9.1)	3 (33.3)
Quinolones	Ofloxacin	9 (16.9)	4 (16.6)	1 (9.09)	0 (0)
	Levofloxacin	8 (15.1)	3 (12.5)	1 (9.1)	3 (33.3)
	Ciprofloxacin	9 (16.9)	2 (8.30)	1 (9.1)	0 (0)
	Nalixidic acid	15 (28.3)	11 (45.8)	2 (18.2)	1 (11.1)
Macrolids	Erythromycin	-	-	-	7 (77.8)
	Clarithromycin	-	-	-	8 (88,88)
Peptides	Lincomycin	-	-	-	3 (33.3)
	Vancomycin	-	-	-	4 (44.4)
	Fusidic acid	-	-	-	2 (22.2)
Other class	Colistin sulfate	15 (28.3)	9 (37.5)	3 (27.3)	5 (55.6)

Note. - : Not performed.

Similarly, girls were more affected by UTI than their boy counterparts (37.03% vs. 27.96, respectively) and the association was statistically significant (P=0.0236). This is in line with the results of many previous reports which emphasized that girls exhibited a higher risk of UTI (5,7-11,16,19,20). The shorter length of the urethra and its proximity to the anus in girls enhanced the scope for the pathogens to invade the bladder which resulted in lower UTI. Additionally, Saeed et al pinpointed that the infrequent micturition in girls may increase the risk of bacterial colonisation, and consequently, the infection of the bladder (11). Conversely, Ousseini reported a higher risk of UTI in boys (21). This inversion of the causal relationship may be due to the fact that the authors are interested in UTI in malnourished children.

Twenty germ species were isolated in this study and the gram-negative bacteria were mostly implicated in UTI (90.9%). This is consistent with the findings of several previous reports which outlined them as the main causative germs of UTI (2,5,7-9,17). Similarly, the Gram-positive cocci represented only by *S. aureus* was regarded as the second causal bacterial group. The ability of Gram-negative germs to produce diverse virulence factors such as adhesins or enzymes may be related to their predominance as germs responsible for UTI (13).

Escherichia coli, E. cloacae, *K. pneumoniae,* and *S. aureus* were the most common germs involved in UTI, which demonstrates that UTI possesses a major implication of these germs in this study. This conclusion obviously varies when analysing the results on the same topic and other studies (5, 13, 22, 23). For instance, Ben Abdallah et al reported *E. coli* (76%), *Klebsiella sp*. (10.5%), and *P. mirabilis* (4%) as the main causative uropathogens (13). This inter-studies variability reinforces the aforementioned assumption about the heterogeneity of UTI over time and space. However, the findings of these studies corroborate with the fact that *E. coli* is the most prevalent germ responsible for UTI (18,24,25).

Our results about the antimicrobial sensitivity highlight the universal problem of resistance. Four major germs species were found in this study, namely, *E. coli, E. cloacae*, *K. pneumoniae,* and *S. aureus*. Overall, the resistance of these germs species was more accentuated (i.e., more than 50%) for the antibiotic classes of penicillins, along with first, second, and third generation cephalosporins. This could be a consequence of high selective pressure due to abusive prescription and the intake of antibiotic drugs (26) was often related to probabilistic treatment and self-medication, respectively (12).

The resistance was the highest against penicillins (amoxicillin 96.2% and clavulanic acid 90.6%) in *E. coli* isolates. This is in conformity with the findings of previous studies (6,19,27). These isolates were more sensible to aminosids and quinolones antibiotic classes since less than 20% of the isolates were resistant except for nalidixic acid (28.3%).

Regarding *S. aureus* isolates, the resistance pattern was similar to that of the *E. cloacae* and *K. pneumoniae* for penicillins, as well as the first and second generation cephalosporins. Surprisingly, as a proper characteristic, these isolates were resistant to third- and second-generation cephalosporins (77.8% for cefotaxime, ceftriaxone, and ceftazidime) and macrolides (erythromycin 77.8% and clarithromycin 88.8%). These resistance levels are troublesome regarding this pathogen. These bacteria are gaining significance as the causative agents of UTI due to their complex genetic makeup which is responsible for their pathogenicity, toxicity, and the acquisition of resistance trait (28). This genome-based life trait might justify the high rate of resistance recorded in this study. On the other hand, we should be comfortable with our assumption owing to the minor sample size of the *S. aureus* isolates (9 cases) in this study. Further studies with larger sample size are needed to confirm or invalidate our observation.

More importantly, *R. ornithinolytica* and *Salmonella* spp. were found to be involved in some UTI cases in this study. These bacteria are uncommon human pathogens and as a result, the infection cases are rare (29,30). The former is commonly acquired in humans through the ingestion of improperly preserved fish. According to previous research, it is involved in community-acquired cystitis Japanese woman (29). This bacterium can be a pathogen through its ability to express histidine decarboxylase which allows it to elicit histamine toxicity, which is also known as scombroid syndrome (31). In addition, *R. ornithinolytica* is thought to be an emergent threat since it naturally expresses beta-lactamases which render it resistant to commonly used antibiotics (29). As regards *Salmonella* spp., this group of bacteria is generally responsible for typhoid fever. Many reports outlined their implication in UTIs, especially nontyphoidal strains (30,32). Similarly, this pathogen constitutes another health concern as *Salmonella* UTI which may complicate pyelonephritis, kidney failure, renal lithiasis, and chronic bacteriuria. Moreover, *Salmonella* UTI can worsen an enteric *Salmonella* infection (30).

This study has a few limitations. Our results were obtained from one hospital and as a result, cannot be extrapolated to all health facilities. In addition, the susceptibility profile of the isolated bacteria is partial since some antibiotics such as carbapenems were not evaluated in this study.

Conclusions

In general, a high prevalence of UTI was found among under-five children in this study. Further, the gram-negative bacteria group was the main causative agent of UTI with *E. coli* as the commonest isolated germs. The results of this study revealed worrying resistance rates in isolates uropathogens, especially against penicillins in addition to the first, second, and third generation cephalosporins. Since the epidemiology of UTI varies over time and due

to geographical areas and the growing risk of multidrug resistance, it would be crucial to periodically monitor the sensitivity pattern of the uropathogens in order to mitigate the wastage of antibiotic drugs related to probabilistic treatment in health facilities.

Ethical Approval

The study was approved by the Regional Delegation of Public Health for Littoral Region, Douala. The ethical clearance was provided by the Bonassama District Hospital (N° HDB/140/15/2013/T). Before applying the inclusion procedure, the objectives and protocol of the study were explained to children's parents. All children were included in the study upon parental approval following signing informed consent forms. The parents or guardians and their children were informed that their participation in the study was voluntary, and they could withdraw any time without any explanation and repercussion.

Conflict of Interest Disclosures

None.

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