SAS Journal of Medicine
Abbreviated Key Title: SAS J Med
ISSN 2454-5112
Journal homepage: https://saspublishers.com

OPEN ACCESS

Pediatrics

Clinical and Bacteriological Aspect of Febrile Urinary Tract Infections in Suspected Children in Kisantu and Kimpese in the Kongo-Central Province of the Democratic Republic of Congo

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DOI: https://doi.org/10.36347/sasjm.2025.v11i10.009 | **Received:** 25.08.2025 | **Accepted:** 09.10.2025 | **Published:** 14.10.2025

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Abstract | **Original Research Article**

Introduction*:** Febrile urinary tract infections (FUTIs) are among the most common bacterial infections in children and constitute a major cause of pediatric morbidity worldwide due to their clinical polymorphism, severity, and potential consequences on renal function. ***Objective: To evaluate the clinical picture of IUF in suspected children and to identify bacteria isolated from blood cultures carried out in Kisantu and Kimpese in the Democratic Republic of Congo. ***Methods:*** Descriptive and cross-sectional study based on retrospective data collected between January 2018 and December 2022 in the Kongo-Central province at the Saint Luc Hospital of Kisantu (HSLK) and the Evangelical Medical Institute (IME) of Kimpese. A convenience sample of 171 children meeting the inclusion criteria was retained. Statistical analyses were carried out with R version 4.4.2. Comparisons of proportions were carried out using the Pearson chi-square test with a 95% confidence interval and a significance threshold set at $p < 0.05$. ***Results:*** One hundred and seventy-one children suspected of IUF had blood cultures performed; 161 or 94.1% came from HSLK with 39 or 24.2% significant blood cultures and 10 or 5.8% came from IME/Kimpese with 2 or 20% significant blood cultures. The clinical picture was polymorphic, consisting mainly of non-specific general signs (fever 100%, chills 90.5%) in infants and specific signs (lumbar pain 82.6%, sensitivity of ureteral points 73.9% and Giordano + 87%) as age advanced. Five germs were isolated: E. *coli* 10 or 5.8%; *Klebsiella pneumoniae* 4 or 2.3%; *Salmonella sp* 15 or 8.7%; *Salmonella Typhi* 8 or 4.6%; *Staphylococcus aureus* 4 or 2.3%). ***Conclusion:*** IUF mainly affects very young children with a generally balanced distribution by sex. Their clinical presentation is polymorphic in infants but specific in older children. Salmonella sp. and E. coli are the most common bacteria with variations according to age and sex. These results provide essential local data to guide diagnostic and therapeutic strategies in pediatrics and highlight the need for additional studies on a larger scale and with longitudinal follow-up.

Keywords: Febrile urinary tract infection, epidemiology, bacteriology.

1. INTRODUCTION

Febrile urinary tract infections (UFI) are one of the most common bacterial infections in children and represent a major cause of global pediatric morbidity often related to upper urinary tract involvement [1]. Internationally, the annual incidence in children aged 0 to 17 years is estimated at approximately 1.3 episodes per 100 patient-years, with a predominance in girls and infants [2]. Among febrile children, 2 to 20% of cases are attributable to a UTI, and several meta-analyses report a prevalence of 10 to 15% in mixed series with *Escherichia coli* as the predominant agent [3-4].

In sub-Saharan Africa, IUF is also a common cause of fever in children with a hospital prevalence of 10–30%. The dominant agents are *E. coli*, *Klebsiella spp.* and *Proteus spp.* with an increasing proportion of strains resistant to common antibiotics [5–6].

In the DR Congo, data come mainly from local hospital studies, reporting a prevalence of around 7.5% in febrile children. *E. coli* remains the main agent followed by other enterobacteria with a high proportion of strains producing extended-spectrum beta-lactamases (ESBL), complicating empirical management [7]. UFIs cause high morbidity and significant socioeconomic

costs for families, particularly in low-resource settings [1-8].

Diagnosis is based on clinical findings but requires additional testing. A leukocyturia $>10^4$ leukocytes/ml associated with the isolation of a single organism at 10^4–10^5 bacteria/ml is the norm [9]. However, identification of the causative agent is not always possible, limiting targeted antibiotic therapy and increasing the risk of resistance [10]. Blood cultures are also recommended for IUF, especially in children, to detect bacteremia or coinfection, while rapid tests such as urine dipsticks remain useful for initial screening but must be confirmed by urine culture and antibiogram [10-12].

In the province of Kongo-Central, which has two main blood culture collection sites by the National Institute of Biomedical Research (INRB), no specific pediatric study has yet been conducted. Given the spatio-temporal variability of microbial ecology and the scarcity of local data, it appears essential to conduct the present study, the objective of which is to evaluate the clinical picture of febrile urinary tract infections (FUTI) in suspected children and to identify the bacteria isolated from the blood cultures performed.

2. METHODS

2.1. *Type of study, period of study and framework of study*

This is a descriptive and cross-sectional study conducted using data collected retrospectively over a five-year period, from January 2018 to December 2022. The study was carried out in the Kongo-Central province, in the southwest of the Democratic Republic of Congo, in two general referral hospitals: HSLK and IME of Kimpese. These two health care establishments (ESS) have been actively participating in the bacteremia surveillance network for more than fifteen years and have particularly detailed microbiological databases.

2.2. *Study population and sample*

The study population consisted of all patients aged 0 to 17 years who underwent a blood culture with IUF as an indication for collection during the period of our study in one of the selected sites, i.e. 193 children. A non-probability convenience sample was selected comprising 171 children meeting the inclusion criteria. This methodological choice is explained by the retrospective nature of the study, as well as by the availability of complete and usable records, including the results of microbiologique examinassions.

2.3. Inclusion criteria

All children aged 0 to 17 years with suspected IUF who underwent a urine dipstick test and blood culture and whose clinical and hematological records were complete.

2.4 Exclusion criteria

Patients who received empirical antibiotic treatment more than 48 hours before sampling, in order to limit false negatives.

2.5 Data collection technique

The study was conducted in two complementary parts. The first consisted of a documentary analysis based on the exploitation of the blood culture database of the INRB in Kinshasa in order to identify cases related to IUF. The second part focused on the analysis of clinical records of children suspected of IUF who had benefited from a blood culture. To do this, a collection was carried out at the HSLK and the IME of Kimpese in order to gather epidemiological, clinical and biological information from the medical records of patients identified in the database.

2.6. Statistical analyses

All statistical analyses were performed using R software version 4.4.2. Descriptive analysis included the calculation of frequencies, proportions, and means with standard deviations. Results were presented in tables and graphs. In bivariate analysis, comparison of proportions was performed using Pearson's chi-square test. Comparison of means between two independent samples was performed using Welch's *t- test* . For all statistical analyses, results were presented with a 95% confidence interval, and the significance level was set at $p < 0.05$.

2.5. Ethical considerations

The study protocol was approved by the scientific committees of HSLK and IME. In accordance with the principles of the revised Declaration of Helsinki (2013) and the recommendations of the ethics committees, the anonymity and confidentiality of participants were strictly respected. All data were anonymized both during registration and in the database provided by the INRB, and no information allowing patient identification was retained. Given the retrospective nature of the study, individual informed consent was not required.

3. RESULTS

In our study, the overall prevalence of positive blood cultures in children with suspected IUF was 23.9% (41/171), i.e. 24.2% at HSLK and 20% at IME.

Table 1: Distribution of children suspected of having IUF according to clinic and age groups

Characteristic	Total N = 171 [1]	0 – 23 N = 53 [1]	24 – 59 N = 40 [1]	60 – 119 N = 32 [1]	120 - 204 N = 46 [1]	p-value
Fever						
Yes	171 (100.0%)	53 (100.0%)	40 (100.0%)	32 (100.0%)	46 (100.0%)	
Thrill						**<0.001** [2]
No	51 (29.8%)	5 (9.4%)	4 (10.0%)	8 (25.0%)	34 (73.9%)	
Yes	120 (70.2%)	48 (90.6%)	36 (90.0%)	24 (75.0%)	12 (26.1%)	
Physical asthenia						**0.007** [2]
No	77 (45.0%)	33 (62.3%)	19 (47.5%)	9 (28.1%)	16 (34.8%)	
Yes	94 (55.0%)	20 (37.7%)	21 (52.5%)	23 (71.9%)	30 (65.2%)	
Abdominal pain						**<0.001** [2]
No	71 (41.5%)	45 (84.9%)	12 (30.0%)	8 (25.0%)	6 (13.0%)	
Yes	100 (58.5%)	8 (15.1%)	28 (70.0%)	24 (75.0%)	40 (87.0%)	
Anorexia						**0.010** [2]
No	79 (46.2%)	30 (56.6%)	22 (55.0%)	7 (21.9%)	20 (43.5%)	
Yes	92 (53.8%)	23 (43.4%)	18 (45.0%)	25 (78.1%)	26 (56.5%)	
Vomiting						>0.9 [2]
No	57 (33.3%)	18 (34.0%)	14 (35.0%)	10 (31.3%)	15 (32.6%)	
Yes	114 (66.7%)	35 (66.0%)	26 (65.0%)	22 (68.8%)	31 (67.4%)	
Diarrhea						**<0.001** [2]
No	92 (53.8%)	25 (47.2%)	12 (30.0%)	19 (59.4%)	36 (78.3%)	
Yes	79 (46.2%)	28 (52.8%)	28 (70.0%)	13 (40.6%)	10 (21.7%)	
Smelly urine						0.3 [3]
No	145 (84.8%)	48 (90.6%)	34 (85.0%)	24 (75.0%)	39 (84.8%)	
Yes	26 (15.2%)	5 (9.4%)	6 (15.0%)	8 (25.0%)	7 (15.2%)	
Lower back pain						**<0.001** [2]
No	104 (60.8%)	53 (100.0%)	33 (82.5%)	10 (31.3%)	8 (17.4%)	
Yes	67 (39.2%)	0 (0.0%)	7 (17.5%)	22 (68.8%)	38 (82.6%)	
Tenderness at ureteral points						**<0.001** [2]
No	83 (48.5%)	53 (100.0%)	12 (30.0%)	6 (18.8%)	12 (26.1%)	
Yes	88 (51.5%)	0 (0.0%)	28 (70.0%)	26 (81.3%)	34 (73.9%)	
Giordano positive						**<0.001** [3]
No	90 (52.6%)	53 (100.0%)	30 (75.0%)	1 (3.1%)	6 (13.0%)	
Yes	81 (47.4%)	0 (0.0%)	10 (25.0%)	31 (96.9%)	40 (87.0%)	

[1] n (%) [2] Pearson's Chi-squared test

[3] Fisher's exact test

Table 2: Distribution according to germ isolates by sex

Feature	Male n = 18	Female n = 23	Total N =41
Types of germs			
Escherichia coli	2 (4.9%)	8 (19.5%)	10 (24.4%)
Klebsiella pneumoniae	3 (7.3%)	1 (2.4%)	4 (9.7%)
Salmonella sp	8 (19.5%)	7 (17.1%)	15 (36.6%)
Salmonella Typhi	2 (4.9%)	6 (14.6%)	8 (19.5%)
Staphylococcus aureus	3 (7.3%)	1 (2.4%)	4 (9.7%)

Table 3: Distribution of the clinic according to germs

Aspects clinics	Escherichia coli N = 10 [1]	Klebsiella pneumoniae N = 4 [1]	Salmonella sp N = 15 [1]	Salmonella Typhi N = 8 [1]	Staphylococcus aureus N = 4 [1]	p-value
Background						
Circumcision	2 (100.0%)	1 (33.3%)	5 (55.6%)	2 (100.0%)	3 (100.0%)	0.3 [2]
IU	0 (0,0%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	1 (25,0%)	0,2[2]
Clinique						
Fièvre	10 (100,0%)	4 (100,0%)	15 (100,0%)	8 (100,0%)	4 (100,0%)	
Frisson	4 (40,0%)	4 (100,0%)	12 (80,0%)	4 (50,0%)	4 (100,0%)	0,059[2]
Asthénie	5 (50,0%)	0 (0,0%)	3 (20,0%)	4 (50,0%)	2 (50,0%)	0,2[2]
Abdominal pain.	7 (70.0%)	1 (25.0%)	5 (33.3%)	7 (87.5%)	2 (50.0%)	0.062 [2]
Anorexia	5 (50.0%)	0 (0.0%)	4 (26.7%)	6 (75.0%)	4 (100.0%)	**0.009** [2]
Vomiting	7 (70.0%)	2 (50.0%)	13 (86.7%)	7 (87.5%)	3 (75.0%)	0.4 [2]
Diarrhea	6 (60.0%)	1 (25.0%)	9 (60.0%)	1 (12.5%)	0 (0.0%)	**0.047** [2]
Urinates badly.	1 (10.0%)	1 (25.0%)	3 (20.0%)	1 (12.5%)	1 (25.0%)	>0.9 [2]
Lower back pain	7 (70.0%)	1 (25.0%)	1 (6.7%)	7 (87.5%)	3 (75.0%)	**<0.001** [2]
PU sensitivity	6 (60.0%)	0 (0.0%)	5 (33.3%)	8 (100.0%)	1 (25.0%)	**0,002**[2]
Giordano +	6 (60,0%)	1 (25,0%)	1 (6,7%)	8 (100,0%)	3 (75,0%)	**<0,001**[2]
[1]n (%)						
[2]Fisher's exact test						

4. DISCUSSION

Febrile urinary tract infections (UTIs) are a major public health problem in children, both in terms of morbidity and risk of complications. In the absence of sufficient local data, our study aimed to describe their clinical profile in suspected children and to identify the bacteria isolated from blood cultures. These results deserve to be interpreted and compared with observations reported in other contexts, in order to identify convergences and specificities.

In our study, the overall prevalence of positive blood cultures in children with suspected UTI was 23.9% (41/171), i.e., 24.2% at HSLK and 20% at the Kimpese IME. This proportion appears significantly higher than those reported in recent literature, where rates of bacteremia associated with pediatric UTIs are generally less than 10%. Thus, Manuel en (2022) observed a prevalence of 10.1% in children under 24 months with a positive urine culture [13], while Cesca en (2022) reported 11.8% of positive blood cultures in an Italian series of several years [14]. These discrepancies may be explained by differences in patient selection, the proportion of very young infants included, the microbiological definition adopted to consider a blood culture as significant, as well as the technical quality of the samples.

In our study, Salmonella sp. was the most frequently isolated bacterium among positive blood cultures, found in 36.6% of children (15/41), with a slight but non-significant male predominance (8 boys, 7 girls). This proportion is relatively high compared to the literature, where Salmonella urinary tract infections are rare, generally representing less than 1% of pediatric UTIs [15-16]. Furthermore, Escherichia coli, usually the most frequent bacterium in pediatric UTIs, was also isolated in our series, confirming international observations that E. coli accounts for 50-80% of pediatric UTIs [17-18]. The sex distribution for E. coli and Salmonella sp . did not show significant differences in agreement with other studies that report a generally balanced distribution between boys and girls, except in certain age groups where girls are slightly more affected [19]. These data suggest that, although E. coli remains the main causative bacterium, Salmonella sp . can constitute a significant proportion of positive blood cultures in certain local contexts, probably linked to specific epidemiological factors, such as gastrointestinal history or local transmission conditions [20]. Taking into account local variability and the age of children is therefore essential to correctly interpret the bacterial distribution of IUF and guide diagnostic and therapeutic strategies.

The clinical picture of urinary tract infections is polymorphic in children. The signs can be classic in older children, while in very young children they are often less obvious, especially non-verbalized and therefore difficult to detect.

In our study, the clinical presentation of infants was dominated by fever, chills and vomiting. Simoës e Silva AC *et al.,* Schalager TA, Bell LE *et al.,* Hudson A *et al.,* and Fitzgerald *et al.,* in their respective studies found that at this age the signs are not very specific and that unexplained fever is the only common sign.[21-22-23-24-25] Then, Leung AK, Chang SL *et al.,* Afzal N *et al.,* Shahian M *et al.,* found irritability, anorexia, vomiting, abdominal pain as other non-specific signs at this age[26-29]. And finally, Gauthier M *et al.,* found that the emission of foul-smelling urine as well as the

discomfort of the infant during the emission of urine can constitute specific signs [22]. Our study is therefore close to those mentioned above. The predominance of general signs at this age is due to the fact that these are very often upper urinary tract infections and that hematogenous disseminations are frequent.

In young children, in our study, in addition to these 3 general signs (fever, chills, vomiting), diarrhea is added. Therefore, a clinical picture of febrile gastroenteritis. And finally, the older we get, the more specific signs gradually become established. Korbel L *et al.,* found that fever, chills, vomiting, malaise, abdominal pain and lower back pain are the predominant signs of febrile urinary tract infection at this age. [23]

5. CONCLUSION

Febrile urinary tract infections therefore constitute a real public health problem in this environment due to their morbidity. They are frequent in the province of Kongo-Central. Their clinical presentation is polymorphic in infants but specific in older children. Enterobacteriaceae are the most frequently encountered germs but with a very high resistance rate.

6. Limitations of the study

Unfortunately, we were unable to access the results of the urine cytobacteriological examination (ECBU) in order to compare the results of the urine cultures with those of the blood cultures. Only those from the BU were available and led to the suspicion of IUFs.

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