Antimicrobial susceptibility pattern of aerobic bacteria isolated from urine of hospitalized children with urinary tract infection

ABSTRACT

Introduction:
Urinary tract infection (UTI) is one of the most common bacterial disease in children, it is acquired by an estimated 3–5% of girls and 1% of boys and represent a significant source of exposure to antibiotics in the pediatric population, The initial treatment of acute UTI is based on patient symptomatology and urinalysis without microbiological confirmations.

Objective: this study aimed to investigate the causative agent of urinary tract infection in children and the resistance rate and to recommend the appropriate antibiotic.

Material and method: in this study, we evaluated causative agent and antimicrobial resistance in urine isolate from the positive cases in Gaafar Bin Ouf Children's Hospital in Khartoum-Sudan.

Result: A total of 67 isolated organisms of urine sample were identified, of which 24(35.8%) were from male and 43(64.2%) were female . They were 7-16 years old. The most common causative agent was staphylococcus aureus 24 (35.8% of cases) followed by klebsiellaspp 20 (29.9%), E. coli 14(20.9%), pseudomonas 8(11.9%) and proteus 1(1. 5%). The lowest antimicrobial resistance rate among all microorganism were to GENTAMICIN (40.3%), CIPROFLOXACIN (43.3%) and PENICILLIN (46.3%), while the highest were to AMOXYCLAV (68.7%) and ERYTHROMYCIN (61.2%)

Conclusion: As a result, we observed the most causative agent of UTIs in children was staphylococcus aureus, a high rate of resistance was to AMOXYCLAV and ERYTHROMYCIN.

Comment [L1]: 1.**Clarity in the Problem Statement**:
- The problem statement in the introduction could be more concise. For instance, the phrase "it is acquired by an estimated 3–5% of girls and 1% of boys and represent a significant source of exposure to antibiotics in the pediatric population" is informative but could be streamlined to focus on the high prevalence and antibiotic exposure risks.

2.**Objective Statement**:
- The objective is clear but could be rephrased for better readability. Consider rewording it to: "This study aimed to identify the causative agents of urinary tract infections (UTIs) in children, analyze their antimicrobial resistance patterns, and recommend appropriate antibiotics for treatment."

3.**Methods Section**:
- Expand slightly on the methods in the abstract to mention the type of study (cross-sectional) and sample size (67 children), as these details are critical for context.

4.**Results Summary**:
- The results are presented clearly, but consider including a mention of the significance of findings, e.g., "Staphylococcus aureus was the most common pathogen (35.8%), highlighting a deviation from the typically reported dominance of Escherichia coli in similar studies."
- The mention of resistance rates is useful, but adding what this implies for clinical treatment would be beneficial.

5.**Conclusion**:
- Strengthen the conclusion by linking the findings to their practical implications. For example: "These findings underscore the need for regular antimicrobial resistance monitoring and suggest revising empirical antibiotic treatments in hospitalized children with UTIs."

Suggested Revised Abstract:

Abstract

Introduction: Urinary tract infections (UTIs) are among the most common bacterial diseases in children, affecting 3–5% of girls and 1% of boys, and leading to significant antibiotic exposure in this population. Initial UTI treatment is often empirical, based on symptomatology without microbiological confirmation.

Objective: This study aimed to identify the causative agents of UTIs in children, evaluate antimicrobial resistance rates, and recommend appropriate antibiotics.

Materials and Methods: A cross-sectional study was conducted on 67 urine samples collected from hospitalized children at Gaafar Bin Ouf Children's Hospital in Khartoum, Sudan. Samples were processed for bacte... [1]

Introduction:

Urinary tract infection (UTI) is one of the most common bacterial disease in children; it is acquired by an estimated 3–5% of girls and 1% of boys and represent a significant source of exposure to antibiotics in the pediatric population (1–3)The initial treatment of acute UTI is based on patient symptomatology and urinalysis without microbiological confirmations (1–3).Early diagnosis and prompt antimicrobial treatment are required to minimize mortality including renal abscess formation, septicemia, renal scarring, and even renal failures (4). Moreover, they constitute a serious economic cost for countries. The economic impact may, however, be substantial because of the large number of acutely unwell children who present to primary care, additional diagnostic tests for structural abnormalities of the urinary tract, rare but serious complications of UTI, and the wider impact of antibiotic prescribing on bacterial resistance. Loss of time in school for children and loss of parental workforce loss are indirect costs (5, 6).The initial choice of antibacterial therapy is based on knowledge of the predominant pathogen in the patient's age group, antibacterial sensitivity patterns in the practice area, the clinical status of the patient, and the opportunity for close follow-up (2, 4).The initial choice of antibacterial therapy is based on knowledge of the predominant pathogen in the patient's age group, antibacterial sensitivity patterns in the practice area, the clinical status of the patient, and the opportunity for close follow up (2, 4).The current American Academy of Pediatrics guideline for management of UTIs in febrile infants and young children suggests giving oral or parenteral (then changed to oral) antibiotics for 7–14 days. Ceftriaxone, cefotaxime, ceftazidime, gentamicin, tobramycin, and pi, peracillin are drugs of choice for parenteral therapy. By contrast, amoxicillin clavulanate, sulfonamide (trimethoprimsulfamethoxazole or sulfisoxazole), or cephalosporin (cefixime, cefpodoxime, cefprozil, cefuroxime axetil, or cephalexin) are recommended as oral agents for treating UTI (7, 8) Studies of pediatric uropathogens indicate that resistance to common antibiotics is on the rise (9) and treatment of UTIs is becoming more difficult with time. Moreover, there are considerable geographic variations in bacterial patterns and resistance properties depending on local antimicrobial prescription practices (2, 8, 10, 11) However, because of the evolving and continuing antibiotic resistance phenomenon, regular monitoring of resistance patterns is necessary to improve guidelines for empirical antibiotic therapy.

UTI mostly occurs during the first year of life in boys, much more commonly in uncircumcised boys. The prevalence of UTI varies with the age. During the first year of life,

the male to female ratio range is 2.8–5.4. Beyond 1–2 years, there is a striking female preponderance with a 1:10 male to female ratio.

*Escherichia coli*spp corresponds with 75%–90% of all UTIs, followed by *Klebsiella*spp and *Proteus*spp species in females, but previous reports have showed that *Proteus*spp is as common as *E. coli* in UTIs of males aged >1 year. Others report a preponderance of Gram-positive organisms in UTIs of males. *Staphylococcus saprophyticus* and *Enterococcus*spp are UTI causative pathogens in both sexes.

Materials and methods:

Study design

A cross-sectional study was carried out during the period from August to December 2021 at Children admitted to Gaafar Bin Ouf Children's Hospital. The study includes patients clinically diagnosed by having one or more of the following symptoms: dysuria, frequency, urgency, suprapubic discomfort, or flank pain. Children suffering from other diseases than UTIs were excluded from the study. A total of 67 patients (24 males and 43 females). All patients were informed of the purpose of the study and their consent, or that of their care provider, was obtained before urine samples were collected.

Comment [L2]: How this sample size was calculated

Sample collection and Processing

Each patient was asked to collect approximately 10-20 ml of midstream urine into a sterile urine container. After giving proper instructions to avoid contamination and samples were processed in the laboratory within 2 hours of collection. None of the patients admitted to consuming antibiotics during the 2 weeks prior to urine sample collection.

Data collection

A structured questionnaire and referring to the patient clinical sheet were being used to collect demographic information and other data (clinical symptoms, previous antibiotic, duration of antibiotic used). verbal consent was obtained from each patient enrolled in this study.

Isolation and identification of Escherichia Coli using biochemical tests and selective medium

Urine cultures were performed using a semi-quantitative technique whereby urine samples were inoculated on cysteine-Lactose electrolyte deficient (CLED) medium plates with a calibrated loop (0.001ml) and incubated at 37°C for 18-24 hours.

Urine culture reports that exhibited colony forming units (CFUs) more than 105/ ml of voided urine were considered significant [12].

Isolated colonies from significant plates were identified and differentiated from related organisms using standard conventional biochemical tests (Kligler Iron agar:; Motility test; Indole, Urease; Citrate)**.**

Antimicrobial susceptibility testing

Antimicrobial sensitivity testing of all isolates was performed on diagnostic sensitivity test plates according to the Kirby-Bauer method [13] following the definition of the Committee of Clinical Laboratory International Standards [14]. Bacterial inoculums were prepared by suspending the freshly grown bacteria in 5mL sterile saline. A sterile cotton swab was used to streak the surface of Mueller Hinton agar plates. Filter paper disks containing a designated concentration of the antimicrobial drugs were obtained from Hi-Media Laboratories in the following:, Gentamicin, Amoxyclin, ciprofloxacin, Erythromycin and Penicilin. The diameters of the zone of inhibition were interpreted according to CLSI standards.

Comment [L3]: Please mention disc size

Results

A total of 67 isolated organisms of urine sample were identified, of which 24(35.8%) were from male and 43 (64.2%)were female as shown in table (1). Their mean age was 7-16 years old, as shown in table (2). Distribution of ages in the study group as shown in tables (3) the most causative agent was staphylococcus aureus 24 (35.8% of cases) followed by klebsiella pneumoniae 20 (29.9%), E. coli 14 (20.9%), pseudomonas 8 (11.9%) and proteus 1(1. 5%) has showed table (4).The lowest antimicrobial resistance rate among all microorganism where to GENTAMICIN (40.3%),CIPROFLOXACIN (43.3%) andPENICILLIN (46.3%), while the highest were to AMOXYCLAV (68.7%) and ERYTHROMYCIN (61.2%) as shown in tables (5/6/7/8/9)

Comment [L4]: Please write the susceptibility profile of each organism

Frequency Tables

Table (1): Distribution of gender in the study group

		Frequency	Percent
N	Male	24	35.8
	Female	43	64.2
	Total	67	100.0

Table (2): Mean and median of Ages in the study group

Age: Statistics	
N	67
Mean	12.49
Median	12.00

Table (3): Distribution of ages in the study group

		Frequency	Percent

N	7-11 yrs	18	26.9
	12-16 yrs	49	73.1
	Total	67	100.0

Table (4): Distribution of Isolated bacteria in the study group

Bacteria	frequency	percentage
S.aureus	24	35.8
E.coli	14	20.9
Klebsiella	20	29.9
Pseudomonas	8	11.9
Proteus	1	1.5
Total	67	100.0

Table (5): Frequencies of antibiotic's sensitivity

PENICILLIN			
		Frequency	Percent
N	sensitive	36	53.7
	resistant	31	46.3
	Total	67	100.0

Table (6):Frequencies of Gentamycin antibiotics sensitivity

GENTAMYCIN			
		Frequency	Percent
N	sensitive	40	59.7
	resistant	27	40.3
	Total	67	100.0

Table (7): Frequencies of Amoxyclav antibiotics sensitivity

AMOXYCLAV			
		Frequency	Percent
N	sensitive	21	31.3
	resistant	46	68.7
	Total	67	100.0

Table (8): Frequencies of Erythromycin antibiotics sensitivity

ERYTHROMYCIN			
		Frequency	Percent
N	sensitve	26	38.8
	resistant	41	61.2
	Total	67	100.0

Table(9):Frequencies of Ciprofloxacin antibiotics sensitivity

CIPROFLOXACIN			
		Frequency	Percent
N	sensitive	38	56.7

	resistant	29	43.3
	Total	67	100.0

Discussion

Urinary tract infection (UTI) is of major clinical importance owing to considerably high morbidity and mortality rates among children. In this study,67 isolated organisms of urine samples were identified.

In this study, the most causative agent was staphylococcus aureus 24 (35.8% of cases) followed by klebsiella pneumoniae 20 (29.9%), E. coli 14 (20.9%), pseudomonas 8 (11.9%) and proteus 1(1. 5%), it disagrees with the result of a study Gunduz in that they reach a result that the most causative agent is Escherichia coli was detected in (58.9%) of the patients, Klebsiella (17.9%) and Proteus (15.8%).

Susceptibility results showed the highest resistance were to Amoxyclav (68.7%) and ERYTHROMYCIN (61.2%), which disagrees with the result of study. Vazouras K *et al*, among 459 prescriptions identified high reported resistance rates to ampicillin (42.0%), Trimethoprim/Sulfamethoxazole (26.5%) and Amoxicillin/Clavulanic acid (12.2%); lower resistance rates were identified for third-generation Cephalosporins (1.7%), Nitrofurantoin (2.3%), Ciprofloxacin (1.4%) and Amikacin (0.9%).

Comment [L5]: Cite this refrence

It also agrees with the result of a study of Ahmed *et al*, they reach a result that of 273 urine samples, drug resistance was found in 92% (n = 82/89) of samples, with most (80%) being resistant to at least two drugs. Antibiotic resistance was commonly observed in Ampicillin (88.3%), Piperacillin (72.7%), Clindamycin (66.7%), Amoxicillin/Clavulanic acid (66.2%), and Trimethoprim/Sulfamethoxazole (50%).

Comment [L6]: Cite reference

The result showed the lowest resistance rate for Gentamicin (40.3%), Ciprofloxacin (43.3%) and Penicillin (46.3%), it disagrees with the result of Gunduz S they reach the result that the lowest resistance to nitrofurantoin (21.4%), Piperacillin/Tazobactam (19.1), Imipenem (8.6%), Meropenem (8.8%), Amikacin (6.2%) and Cefoperazone/Sulbactam (CSL) (4.7%).

Conclusion:

As a result, we observed the most causative agent of UTIs in children was staphylococcus aureus, a high rate of resistance was to Amoxyclave and Erythromycin to staphylococcus aureus organism,Current treatment routines are often inappropriate for hospitalized children with UTI, which is relatively common in this population this study will be useful for physicians to improve appropriate empirical treatment for UTI.

Comment [L7]: Improve this section

References:

1. Elder JS. Urologic disorders in infants and children. In: Behrman RE, Kliegman RM, Jenson HB, editors. Nelson textbook of pediatrics. 18th ed. Philadelphia: WB Saunders; 2010. p. 1829-34.
2. Haller M, Brandis M, Berner R. Antibiotic resistance of urinary tract pathogens and rationale for empirical intravenous therapy. PediatrNephrol. 2004 Sep;19(9):982-6.
3. Hodson EM, Willis NS, Craig JC. Antibiotics for acute pyelonephritis in children. Cochrane Database Syst Rev. 2007(4).
4. American Academy of Pediatrics, Committee on Quality Improvement, Subcommittee on Urinary Tract Infection. Practice parameter: the diagnosis, treatment, and evaluation of the initial urinary tract infection in febrile infants and young children. Pediatrics. 1999;52:843-52.
5. Saadeh SA, Mattoo TK. Managing urinary tract infections. PediatrNephrol. 2011 Nov;26(11):1967-76.
6. Şirin A, Emre S, Alpay H, Nayir A, Bilge I, Tanman F. Etiology of chronic renal failure in Turkish children. PediatrNephrol. 1995 Oct;9(5):549-52.
7. Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management. Urinary tract infection: clinical practice guideline for the diagnosis and management of the initial UTI in febrile infants and children 2 to 24 months. Pediatrics. 2011;128(6):e1574-88.
8. Beetz R, Westenfelder M. Antimicrobial therapy of urinary tract infections in children. Int J Antimicrob Agents. 2011 Dec;38(1):42-50.
9. Chavez-Bueno S, Stull TL. Antibacterial agents in pediatrics. Infect Dis Clin North Am. 2009 Dec;23(4):865-80.
10. Bryce A, Hay AD, Lane IF, Thornton HV, Wootton M, Costelloe C. Global prevalence of antibiotic resistance in paediatric urinary tract infections caused by Escherichia coli and association with routine use of antibiotics in primary care: systematic review and meta-analysis. BMJ. 2016 Mar 15;352:i1065.
11. Demir M, Kazanasmaz H. Uropathogens and antibiotic resistance in the community and hospital-induced urinary tract infected children. J Glob Antimicrob Resist. 2020 Mar;20:68-73.
12. Eremenko R, Barmatz S, Lumelsky N, Colodner R, Strauss M, Alkan Y. Urinary tract infection in outpatient children and adolescents: risk analysis of antimicrobial resistance. Isr Med Assoc J. 2020 Apr 1;22(4):236-40.
13. Bauer AW, Kirby WM, Sherris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. Am J ClinPathol. 1966 Apr;45(4):493-6.
14. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing. 32nd ed. CLSI supplement M100. Wayne, PA: CLSI; 2022.

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