

Evaluation of Bacteriological Profile and Antibiotic Sensitivity Patterns for Enterobacteria in Adults with Urinary Tract Infections: A Retrospective Study

Silab Ong¹, Sophana Sam², Khannara Kheng³, Sikheang Chhiv⁴, Sear Soun⁵,
Sophal Mom⁶, Navuddh Oam^{7*}, Setha Limsreng⁸

^{1,8} Department of Medicine B, Calmette Hospital, Phnom Penh, Cambodia

^{2,4} Khmer-Soviet Friendship Hospital, Phnom Penh, Cambodia

³ Cambodia-China Friendship Preah Kossamak Hospital, Phnom Penh, Cambodia

^{5,6} Health Science Institute of Royal Cambodian Armed Forces, Phnom Penh, Cambodia

⁷ Techo Santepheap National Hospital, Phnom Penh, Cambodia

*Corresponding author Email: [na.rcammed\[at\]ymail.com](mailto:na.rcammed[at]ymail.com)

Abstract: Urinary tract infections are very common and represent a public health concern. The most commonly found bacteria are gram-negative bacilli, with *Escherichia coli* being by far the most frequently isolated. This retrospective study aimed to assess the epidemiological, clinical, and biological aspects of urinary tract infections UTIs in adults and evaluate antibiotic resistance patterns. We reviewed 68 adult cases of UTIs confirmed by urine or blood cultures at Calmette Hospital in 2019. The results showed that UTIs were more frequent in women than in men, with an average patient age of 31.27 years. The majority of patients aged between 39-43 years were the most affected (29 cases or 42.65%). The female:male sex ratio was 1.61:1. The most common clinical signs were fever with urinary disturbance (59 cases or 86.76%). The most common bacterial pathogens were *Escherichia coli* and *Klebsiella pneumoniae*. The study also highlighted concerning levels of antibiotic resistance, particularly to penicillin G, while no resistance was observed for imipenem and meropenem. No resistance to imipenem and meropenem was found. The least effective antibiotics were ampicillin, ticarcillin, nalidixic acid, tetracycline, sulfonamides, and trimethoprim. Sensitivity to the combination of amoxicillin+clavulanic acid was notable on our strains of *S. aureus* and coagulase-negative *Staphylococcus*. Urinary tract infections occur primarily in women. The antibiotic resistance rate is very high and concerning for routine practice in the treatment of urinary tract infections, but they can be treated with various lines of antibiotics like ceftriaxone, ciprofloxacin, or augmentin tailored to the antibiogram.

Keywords: Urinary tract infections, *E. coli* bacteria, blood culture; urine culture; antibiogram

1. Introduction

Urinary tract infections (UTIs) are common both in hospital settings and in the community. They occur in children, adults, and the elderly, in both sexes. They occupy an important place among the reasons for consultation. Among nosocomial infections, urinary tract infections hold a significant position. Their high frequency could be attributed to the preferential proliferation of certain germs in the urinary tract and the multiplicity of contributing factors. Given the resurgence and serious consequences that this condition could cause in pregnant women, children, and the elderly, several studies have been dedicated to it [1].

The incidence in developing countries, in the United States, urinary tract infections top the list of nosocomial infections [2]. In France, Veyssier found in his research that infections were mainly urinary after a long hospital stay at 47% and occurred much more frequently in elderly individuals [3]. The most frequently isolated germs are enterobacteria 81%, such as *Escherichia coli* (69.4%), *Proteus mirabilis* (5.2%), *Klebsiella-Enterobacter-Serratia* group (5.3%), *Citrobacter freundii* (1.3%), and gram-positive cocci (12.9%),

Staphylococcus aureus (2.2%), *Staphylococcus epidermidis* (0.7%), *Staphylococcus saprophyticus* (0.6%), other staphylococci (0.1%), *Streptococcus agalactiae* (1.9%), *Enterococcus sp* (7.4%) [4]. *Streptococci* and *Enterococci* are increasingly encountered in urinary tract infections in developing countries due to a lack of public education on hygiene [5].

The diagnosis of urinary tract infections is not always straightforward because clinical signs are not specific and there are many alternative diagnoses. Therefore, confirmatory biological examinations are systematic in medical practice, especially in developing countries such as Cambodia.

We conducted a retrospective study over one year at Calmette Hospital in Phnom Penh on 68 subjects of urinary tract infections confirmed by either blood culture or urine culture with a urinalysis to show the clinical and biological symptoms and treatment efficacy of this disease. The purpose of this study is to determine the prevalence of urinary tract infections in hospitalized adults, identify the main clinical and biological signs, and assess the antibiotic sensitivity patterns of the bacteria responsible for these infections. This study is

significant because it provides crucial insights into the antibiotic resistance patterns of common UTI pathogens in Cambodia, offering valuable information for optimizing treatment strategies and improving patient outcomes.

2. Materials and Methods

2.1 Study population

This was a descriptive, retrospective study. We included all cases of patients having a diagnosis of urinary tract infections confirmed by blood culture, urine culture, and/or urinalysis, aged > 18 years, both sexes, complete records. The exclusion criteria were based on lack of diagnostic confirmation, OPD patients, age < 18 years, and incomplete records. According to which patients are complete according to our criterion; there were 68 cases of urinary tract infection out of 1370 patients who were hospitalized.

2.2 Study setting and questionnaire

The recruitment of cases was carried out at Department of Medicine B, Calmette Hospital (Preah Monivong Blvd, Phnom Penh, Cambodia). Questionnaire using a data collection form, socio-demographic, clinical, therapeutic, and outcome data were collected from the hospitalization records. Data are collected from pre-filled questionnaires and then recorded and analyzed using Excel software.

2.3 Data analysis

All data were stored in Excel and data entry was carried out with coding and verification. For description of baseline characteristics, number and percentage were used for categorical variables, and mean with standard deviation or median with 25th-75th percentile range were used for continuous variable according to their distribution. Baseline characteristics such as gender, age are described in number and percentages for categorical variables, and median and interquartile range for continuous variables.

2.4 Ethical consideration

This study was conducted with approval from the committee of Calmette Hospital, Phnom Penh, Cambodia. All participants were recorded anonymous.

3. Results

3.1 Demographic background and clinical patterns

The number of patients with urinary tract infections is predominantly female, with 42 cases (61.76%), compared to 26 cases in males (38.24%), resulting in a female-to-male sex ratio of 1.61:1. We observed that the minimum age is 19 years and the maximum age was 64 years, with an average age of 31.27 years. The age range was 19-64 years, and the most affected age group is 39-43 years, with 29 cases or 42.65%. The most majority of the female patients, with 22 cases or 32.35%, are involved in farming, followed by workers: 16 cases or 23.53%, vendors: 14 cases or 20.59%, housekeepers: 10 cases or 14.71%, officers: 4 cases or 5.88%, and students: 2 cases or 2.94%. Table 1.

3.2 Clinical manifestations and causative pathogens

The majority of female patients consulted for fever, with 57 cases, or 83.82%, accompanied by urinary symptoms, including burning sensation during urination: 48 cases or 70.59%, dysuria: 44 cases or 64.71%, frequent urination (pollakiuria): 42 cases or 61.76%, hematuria: 13 cases or 29.12%, abdominal pain: 9 cases or 13.26%, pyuria: 7 cases or 10.29%, polyuria: 2 cases or 2.94%. Table 2. The most common clinical signs to define urinary tract infections were presented as fever with urinary symptoms: 59 cases or 86.76%, chills, urinary symptoms, and back pain 11 cases or 16.18%, fever chills, and urinary symptoms 5 cases or 7.35%. Table 3. The majority of germs causing urinary tract infections are *Escherichia coli* (22 cases or 32.35%). We observed that all patients had the causative bacteria isolated. Table 4.

3.3 Antibiotic Sensitivity for the Causative Bacteria

There were more antibiotics sensible to *E. coli* such as mipenem, colistin, meropenem, piperacillin-tazobactam, levofloxacin, ceftriaxone, ciprofloxacin, ceftioxin, amikacin, and gentamicin are the most active antibiotics. There were less remained resistant to the pathogen. Table 5.

The antibiotic sensitivity showed that imipenem and meropenem were effective in 100% of the cases, followed by: Piperacillin+tazobactam (Tazilin®): 61 cases or 91.04%, Amikacin: 57 cases or 85.07%, Ceftriaxone: 56 cases or 83.58%, Levofloxacin: 50 cases or 74.63%, Ciprofloxacin: 47 cases or 70.15%, Gentamicin: 39 cases or 58.21%, Amoxicillin+clavulanate (Augmentin®): 25 cases or 37.31%. Table 6.

The antibiotic used, either alone or in combination, was ceftriaxone in 100% of the cases, with monotherapy based on antibiogram in 5 cases or 7.35%, including piperacillin+tazobactam (Tazilin®) in 3 cases or 4.41% and meropenem in 2 cases or 2.94%. Table 7.

Table 1: Characteristics of study subjects

Characteristics	Total Subjects, n (%)
Gender	68 (100)
Female	42 (61.76)
Male	26(38.24)
Age group (years)	68 (100)
19-23	4 (5.88)
24-28	6 (8.82)
29-33	8 (11.76)
34-38	14 (20.59)
39-43	29 (42.65)
> 43	7 (10.29)
Occupation	58 (100)
Farmer	22 (32.35)
worker	16 (23.53)
vendor	14 (20.59)
housekeeper	10 (14.71)
Officer	4 (5.88)
Student	2 (2.94)

Table 2: Clinical symptoms at admission

Symptoms	Total Subjects, n (%)
Fever	57 (83.82)
Painful urination	48 (70.59)
Dysuria	44 (64.71)
Pollakiuria	42 (61.76)
Bloody urine	13 (19.12)
Abdominal pain	9 (13.24)
Pyuria	7 (10.29)
Polyuria	2 (2.94)

Table 3: Clinical signs of study subjects

Clinical signs	Total Subjects, n (%)
Fever and urinary symptoms	59 (86.76)
Chills, urinary symptoms, and back pain	11 (16.18)
Fever, chills, and urinary symptoms	5 (7.35%)

Table 4: Distribution of patients based on the causative bacteria

Clinical signs	Total Subjects, n (%)
<i>Escherichia coli</i>	22 (32.25)
<i>Klebsiella pneumoniae</i>	15 (22.06)
<i>Staphylococcus aureus</i>	11 (16.18)
<i>Pseudomonas aeruginosa</i>	7 (10.29)
<i>Streptococcus spp</i>	6 (8.82)
<i>Staphylococcus, coagulase-negative</i>	4 (5.88)
<i>Acinetobacter spp</i>	2 (2.94)
Sterile	1 (1.47)
Total	68 (100)

Table 7: Distribution of patients according to the antibiotics used

Antibiotics used	Total Subjects, n (%)
Ceftriaxone	68 (100)
Gentamycin	60 (88.24)
Ciprofloxacin	19 (27.94)
Amikacin	8 (11.76)
Piperacillin+tazobactam (Tazilin®)	3 (4.41)
Meropenem	2 (2.94)

Table 5: Antibiotic Sensitivity of 22 Cases of *Escherichia coli*

Antibiotics	Sensible (n%)	Intermediate (n%)	Resistant (n%)
Penicilline	-	-	22 (100)
Amoxicilline	3 (13.64)	2 (9.09)	17 (77.27)
Amoxicilline+clavulanate	5 (22.73)	4 (18.18)	13 (59.09)
Colistine	22 (100)	-	-
Piperacilline+tazobactam	21 (95.45)	1 (4.55)	-
Imipenem	22 (100)	-	-
Meropenem	22 (100)	-	-
Cefoxitine	15 (68.18)	4 (18.18)	3 (13.64)
Cefotaxime	18 (81.82)	4 (18.18)	-
Ceftriaxone	19 (86.36)	3 (13.64)	-
Acide nalidixique	6 (27.27)	11 (50.00)	5 (22.73)
Ciprofloxacin	20 (90.91)	1 (4.55)	1 (4.55)
Norfloxacin	-	12 (54.55)	10 (45.45)
Levofloxacin	21 (95.45)	1 (4.55)	-
Gentamicine	15 (68.18)	7 (31.82)	-
Amikacine	18 (81.82)	4 (18.18)	-
Tetracycline	-	1 (4.55)	21 (95.45)
Cotrimoxazole	-	-	22 (100)

Table 6: Sensitivity to the main antibiotics used for the 68 cases

Type d'antibiotiques testé	Sensible (n%)	Intermediate (n%)	Resistant (n%)
Imipenem	67 (100)	-	-
Meropenem	67 (100)	-	-
Piperacilline+tazobactam (Tazilin®)	61 (91.04)	5 (7.46)	1 (1.49)
Amikacine	57 (85.07)	8 (11.94)	2 (2.99)
Ceftriaxone	56 (83.58)	9 (13.43)	2 (2.99)
Levofloxacin	50 (74.63)	15 (22.39)	2 (2.99)
Ciprofloxacin	47 (70.15)	10 (14.93)	10 (14.93)
Gentamicine	39 (58.21)	17 (25.37)	11 (16.42)
Amoxicilline+clavulanate Augmentin®)	25 (37.31)	19 (28.36)	23 (34.33)

4. Discussion

The age range of our patients was between 39-43 years (42.65% of cases). In Sissoko MT's study, the age range was broader, between 36-65 years (38% of cases) [6]. The study by Lyna L et al. found the most affected age group to be older, at around 60 years (41.02% of cases) [7]. This high proportion of older adults in our study could be explained by risk factors mentioned in the literature. In our study, patients were predominantly female in 61.76% of cases and male in 38.24%. In Sissoko MT's study, patients were also predominantly female in 56.02% of cases and male in 43.98% [6]. The study by Lyna L et al. showed 69.23% female and 30.77% male [7].

In our study, the reasons for patient admission varied, with fever being most common in 83.82% of cases. In contrast, Sissoko MT's study found fever as a reason for admission in only 17.3% of cases. Meanwhile, Barbara MC's study reported burning sensation during urination as the main reason for admission (94%), which is higher than in our study (70.59%) and in Sissoko MT's study (30.7%) [8]. Over one year, we isolated 68 bacterial strains, with 67.64% being Gram-negative bacilli, 30.88% Gram-positive cocci, and 1.47% being sterile. Sissoko MT's study found 71.16% Gram-negative bacilli and 28.84% Gram-positive cocci [6]. The study by Lyna L et al. reported 84.61% Gram-negative bacilli and 15.39% Gram-positive cocci [7]. In our study, the antibiotic sensitivity of *Escherichia coli* was 100% for imipenem, meropenem, and colistin. Sissoko MT's study and the study by Lyna L et al. also found 100% sensitivity to colistin for *Escherichia coli*.

5. Conclusion

This study highlights the high prevalence of urinary tract infections among hospitalized adults, with *Escherichia coli* being the most commonly isolated pathogen. Antibiotic resistance rates were notably high, particularly for penicillin G, emphasizing the need for ongoing surveillance and tailored treatment approaches based on local antibiogram data. Future studies should focus on evaluating newer antibiotics to combat the rising resistance in common UTI pathogens.

Conflict of Interest Statement

All authors disclose no conflict of interest related to this submission.

References

- [1] Mancuso G, Midiri A, Gerace E, Marra M, Zummo S, Biondo C. Urinary Tract Infections: The Current Scenario and Future Prospects. *Pathogens*. 2023 Apr 20;12(4):623.
- [2] Taye ZW, Abebil YA, Akalu TY, Tessema GM, Taye EB. Incidence and determinants of nosocomial infection among hospital admitted adult chronic disease patients in University of Gondar Comprehensive Specialized Hospital, North-West Ethiopia, 2016-2020. *Front Public Health*. 2023 Feb 24;11:1087407.
- [3] Aghayan M, Thoumsin H, Lambotte R. Therapeutic strategies for bacteriuria in pregnancy. *Rev Med Liège* 1990; 45: 433-9.
- [4] Aldiouma H. Prevalence of the association between HIV and urinary tract infection in the internal medicine and hemato-oncology departments of the National Hospital of Point G. Medical Thesis, Bamako, 2000.
- [5] Yan L, Jin Y, Hang H, Yan B. The association between urinary tract infection during pregnancy and preeclampsia: A meta-analysis. *Medicine (Baltimore)*. 2018 Sep;97(36):e12192.
- [6] Sissoko MT. Urinary tract infections in Bamako: epidemiological, bacteriological, and clinical aspects. Faculty of Medicine, Pharmacy, and Dentistry, University of Bamako, 2006.
- [7] Lyna L, Yasmine B. Urinary tract infections. Faculty of Natural and Life Sciences, University of Frères Mentouri Constantine, 2016.
- [8] Barbara MC. Median time and predictive factors of healing time for cystitis in women over 18 in general practice. Faculty of Medicine Paris Descartes, University of Paris Descartes, 2016.