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Bacteriological profiles of urinary tract infections in patients admitted to the nephrology-haemodialysis department of the Bogodogo University Teaching Hospital (CHU B), Ouagadougou, Burkina Faso

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Abstract:

Background: Urinary tract infections (UTI) constitute a major public health problem, especially in developing countries such as Burkina Faso. They are commonly encountered in hospitals, particularly in patients suffering from chronic kidney disease whose management requires special measures to avoid treatment failures which are frequent. The objective of this study is to determine the microbial profiles of urinary tract infections (UTIs) in these patients.
Methodology: This was a cross-sectional study of hospitalized patients with UTIs in the nephrology-haemodialysis department of the CHUB from August 1 to November 31, 2020. Socio-demographic and clinical data of selected patients were collected by a well-designed data collection form. Cytobacteriological analysis of urine (CBAU) was carried out on voided or catheter-urine sample of each patient using standard microbiological technique. The disc diffusion method in agar medium modified according to the recommendations of the 2020 CA-SFM-EUCAST was used to determine the antibiotic susceptibility of each isolate. Data were processed and analyzed using Excel 2013, IBM SPSS Statistics 25.0 and CSpro 7.5 software.
Results: Urine samples were collected from a total of 77 eligible participants, 49 (63.6%) of which were CBAU positive, with 56 microbial pathogens isolated. Enterobacterales represented 58.9% (n=33), including 39.4% *Escherichia coli* (n=13) and 36.4% *Klebsiella* spp (n=12). Non-fermentative Gram-negative bacilli represented 7.1% (n=4) including *Acinetobacter baumannii* (n=3) and *Pseudomonas aeruginosa* (n=1). *Staphylococcus aureus* was isolated in 5.4% (n=3) and *Candida* spp in 28.6% (n=16). The most active antimicrobials *in vitro* against the bacterial pathogens were amikacin and imipenem, and clotrimazole and nystatin against the *Candida* spp. A total 35.7% (n=20) were multi-drug resistant bacteria with 32.1% by ESBL in Gram-negative bacteria and 66.7% (2/3) by MRSA in Gram-positive bacteria.
Conclusion: The high resistance of pathogens to antimicrobials, resulting in therapeutic failures, constitutes a significant challenge in the management of urinary tract infection, especially in people with chronic kidney disease. It is therefore necessary to put in place urgent measures aimed at the rational use of antimicrobials and strict compliance with good hospital hygiene practices.

Keywords: Bacteriological profile; UTI; Nephrology-Haemodialysis; Antimicrobial resistance

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Profils bactériologiques des infections urinaires chez les patients admis au service de néphrologie-hémodialyse du CHU de Bogodogo (CHU B), Ouagadougou, Burkina Faso

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Résumé:

Contexte: Les infections des voies urinaires (IVU) constituent un problème de santé publique majeur, notamment dans les pays en développement comme le Burkina Faso. Ils sont fréquemment rencontrés en milieu hospitalier, notamment chez les patients souffrant d'insuffisance rénale chronique dont la prise en charge nécessite des mesures particulières pour éviter les échecs thérapeutiques qui sont fréquents. L'objectif de cette étude est de déterminer les profils microbiens des infections des voies urinaires (IVU) chez ces patients.
Méthodologie: Il s'agit d'une étude transversale portant sur des patients hospitalisés atteints d'infections urinaires dans le service de néphrologie-hémodialyse du CHUB du 1er août au 31 novembre 2020. Les données sociodémographiques et cliniques des patients sélectionnés ont été collectées par un recueil de données bien conçu. formulaire. L'analyse cytobactériologique de l'urine (CBAU) a été réalisée sur un échantillon d'urine purgé ou cathéter de chaque patient en utilisant une technique microbiologique standard. La méthode de diffusion sur disque en milieu gélose modifiée selon les recommandations du CA-SFM-EUCAST 2020 a été utilisée pour déterminer la sensibilité aux antibiotiques de chaque isolat. Les données ont été traitées et analysées à l'aide des logiciels Excel 2013, IBM SPSS Statistics 25.0 et CSpro 7.5.
Résultats: Des échantillons d'urine ont été collectés auprès d'un total de 77 participants éligibles, dont 49 (63,6%) étaient positifs au CBAU, avec 56 agents pathogènes microbiens isolés. Les Enterobacterales représentaient 58,9% (n=33), dont 39,4% d'*Escherichia coli* (n=13) et 36,4% de *Klebsiella* spp (n=12). Les bacilles Gram négatif non fermentaires représentaient 7,1% (n=4) dont *Acinetobacter baumannii* (n=3) et *Pseudomonas aeruginosa* (n=1). *Staphylococcus aureus* a été isolé dans 5,4% (n=3) et *Candida* spp dans 28,6% (n=16). Les antimicrobiens les plus actifs *in vitro* contre les agents pathogènes bactériens étaient l'amikacine et l'imipénème, ainsi que le clotrimazole et la nystatine contre *Candida* spp. Au total, 35,7% (n=20) étaient des bactéries multirésistantes, dont 32,1% étaient des BLSE chez les bactéries Gram-négatives et 66,7% (2/3) des SARM chez les bactéries Gram-positives.
Conclusion: La forte résistance des pathogènes aux antimicrobiens, entraînant des échecs thérapeutiques, constitue un défi important dans la prise en charge des infections urinaires, notamment chez les personnes atteintes d'insuffisance rénale chronique. Il est donc nécessaire de mettre en place des mesures urgentes visant l'usage rationnel des antimicrobiens et le strict respect des bonnes pratiques d'hygiène hospitalière.

Mots clés: Profil bactériologique; infection urinaire; Néphrologie-Hémodialyse; Résistance aux antimicrobiens

Introduction:

Healthcare-associated infections are at the forefront of healthcare-related adverse events (1). According to the World Health Organization, the prevalence of healthcare-associated infections in Africa varies at hospital level between 2.5% and 14.8% and the risk of contracting an infection during healthcare is 2 to 20 times higher in developing countries than in developed countries (2). Nosocomial infections contracted in a healthcare structure are an integral part of healthcare-associated infections, according to the conclusions of the Committee on Nosocomial Infections and Healthcare-Associated Infections in France, established in 2006 (3).

Urinary tract infections (UTIs) are the most common infections encountered in hospital settings. Indeed, in almost 40% of cases, they are acquired in the hospital (4). Their frequency varies depending on the type of establishment and service. Studies carried out respectively in the urology and nephrology-haemodialysis departments of the Yalgado Ouedraogo University Teaching Hospital (CHUYO), reported prevalence of 65.3% in 2011, 26.8% in 2015 and 43.4% in 2019. These high frequencies were associated in nearly 80% of cases with chronic kidney failure (CKD) which was the first reason for consultation in 54.3% of cases (5).

UTI in people with renal insufficiency is a complicated infection requiring specific diagnostic and therapeutic management (6). This is explained by the fact that most of the patients suffering from CKD have an immunosuppression status which requires particular attention to aseptic conditions during when providing them cares. The numerous invasive maneuvers (such as bladder catheterization, central venous catheterization and urinary tract interventions), and long hospital stay that is often necessary for the care of the patient, constitute factors of infection aggravation. They either facilitate introduction of bacteria into the urinary tract or facilitate their developments. These infections can progress to bacteremia (7).

The high frequency of UTIs occurs in the context of increasing bacterial resistance to antibiotics (8), and this constitutes a major public health challenge, especially in developing countries such as Burkina Faso (9). A study conducted by the Pasteur Institute reported a significant increase in the proportions of extended spectrum β-lactamases (ESBL) for *Escherichia coli*, from 28.9% in 2012 to 48.2% in 2015 (10). This increase in antibiotic resistance could be the cause of numerous therapeutic failures and constitute a problem for the management of UTI in patients suffering from renal failure. The present study initiated in this context could contribute to better management of UTIs in patients hospitalized in nephrology department, through development of guidelines for antibiotic

treatment and prevention of complications through early diagnosis.

Materials and method:

Study setting:

This study was conducted at the nephrology and haemodialysis department of Bogodogo University Teaching Hospital (CHU B) Ouagadougou, Burkina Faso, where urine collection took place and the laboratory department of the hospital where bacteriological analysis was performed.

Study design and period of study:

This was a descriptive cross-sectional study of hospitalized patients whose urine analysis were carried out over a period of four months (August 1, 2020 to November 31, 2020)

Study participants, data and sample collection:

The study participants were non-anuric hospitalized patients in the nephrology-haemodialysis department of the CHUB during the study period, who consented to participate in the study. A well-designed collection form was developed for this purpose to collect information on the demographic characteristics of the participants, clinical data and microbiological results of the laboratory investigation.

The clinical records of the patients served as the data sources. Written instruction on the urine collection technique was provided in advance to the staff of the nephrology-haemodialysis department. Voided urine sample was collected by the "fly or mid-stream technique", and by catheter specimen from those on urinary catheter. Strict aseptic precautions were taken during urine collection.

Ethical considerations:

Ethical approval to conduct the study was granted by the CHUB. Approval to collect urine samples from participants and to perform laboratory analysis were given by the managers of the nephrology and haemodialysis department and the CHUB laboratory respectively. Informed consent was obtained from each patient participant. Confidentiality and anonymity were strictly adhered to.

Urine microscopy and culture:

The cytobacteriological analysis of urine (CBAU) was carried out according to the routine procedures applicable in Burkina Faso, and the interpretation of the results was made according to the recommendations of the "European guidelines for urine analysis" on uropathogenic groups distinguishing microorganisms into four groups according to their involvement in the aetiology of UTI (11).

Each urine sample was systematically inoculated on Cystine Lactose Electrolyte Deficient (CLED), Bromocresol Purple (BCP) and Eosin Methylene Blue (EMB) agar media, and incubated aerobically at 37°C for 24 hours. Following observation of the colonies on the positive culture media and further microscopic examination, additional media were used according to the morphology of the bacteria such as Chapman agar for Gram-positive cocci in clusters and Sabouraud Dextrose-Chloramphenicol agar for yeasts.

Identification of microbial isolates:

Biochemical identification of Gram-positive cocci in clusters was done by performing catalase and coagulase tests and identified to species level using API Staph gallery. Gram-negative bacilli were identified to species level using the API 20E gallery. The BD Phoenix TM M50 was used for confirmation during repeat testing when two organisms were isolated in the same sample. *Candida* species were identified by microscopic observation of refractile ovoid cells with clear contents and confirmed by API *Candida* gallery that is standardized for identification of yeasts.

Antimicrobial susceptibility testing of microbial isolates:

Antimicrobial susceptibility testing of bacterial isolates (antibiogram) was performed using the modified Kirby-Bauer disk diffusion method in agar medium against selected antibiotics as described by the French Society of Microbiology (CASFM2020_Octobre2020_V1.2). Briefly, microbial inoculum from a 24-hour culture was prepared in a tube containing sterile saline solution (5ml of 0.9% NaCl) and standardized to 0.5 MacFarland turbidity standard (equivalent of 10^6-10^8 colony forming unit/ml). The suspension was then inoculated using a sterile swab on sterile Mueller-Hinton (MH) agar plate to obtain a homogeneous distribution of bacteria over the entire surface of the agar. Antibiotic discs were placed on the surface of the agar plate (maximum of six discs for a 90 mm Petri dish) and incubated at 37°C for 24 hours.

The diameter of zone of inhibition of bacterial growth was measured in millimeters and interpreted as sensitive or resistant using the interpretative tables of the 2019 and 2020 CASFM benchmarks. For antibiotic susceptibility test for fungi (antifungogram), the same disc diffusion method was used, with antifungal discs on Sabouraud Dextrose-Chloramphenicol agar.

Phenotypic detection of ESBLs and MRSA:

The test to detect extended-spectrum β-lactamases (ESBLs) production in the isolates

was carried out using the 'double disk synergy test' (DDST) which consists of placing an antibiotic associated with a β-lactamase inhibitor (amoxicillin-clavulanic acid) in the middle of an inoculated Mueller-Hinton (MH) agar plate with two 3rd or 4th generation cephalosporins, placed side-by-side at a distance of 20mm. The presence of a 'champagne cork' image indicates the production of ESBL. For the detection of methicillin-resistant *Staphylococcus aureus* (MRSA), cefoxitin (30µg) disc was used and inhibition zone diameter less than 27 mm indicate MRSA.

Data analysis:

The data were processed and analyzed using Excel 2013, IBM SPSS Statistics 25.0 and CSpro 7.5 software.

Results:

Socio-demographic and clinical characteristics of the study participants:

During the study period, 127 patients were hospitalized in the nephrology and haemodialysis department of CHU B but only 77 (37 females and 40 males) were eligible and selected for cytobacteriological examination of their urine. The sociodemographic characteristics of the 77 participants is shown in Table 1. Of the 77 patient participants, 49 (63.6%) were positive for cytobacteriological analysis of their urine (CBAU) out of which 21 (27.3%) had chronic kidney disease (CKD), 12 (15.6%) had end-stage kidney disease (ESKD) and 10 (13.0%) had acute kidney failure (AKF). UTI was confirmed in 95.9% (47/49) of the CBAU positive patients (or 61.0% of the 77 cases) while 2 patients (2.6%, 2/77) had significant bacteriuria without leukocyturia (no UTI), and 44 (93.6%) of the 47 patients had urinary catheter.

Risk factors for UTI among the study participants:

The only risk factors significantly associated with UTI (CBAU positive) among the participants were age >75 years (OR=0.02, 95% CI=0.0047-0.1186, $p<0.0001$) and age >65 years with at least three frailty criteria (OR= 0.29, 95%CI = 0.0918 - 0.9452, $p=0.0417$). Glomerular filtration rate (GFR) <30ml/min/ 1.73m^2 ($p=0.0966$), pregnancy ($p=0.7003$) and gender (0.6359) were not significantly associated with UTI (Table 2).

Table 1: Socio-demographic and clinical characteristics of hospitalized study participants at the nephrology and haemodialysis department of Bogodogo University Teaching Hospital Ouagadougou, Burkina Faso

Characteristics	CBAU positive n (%)	CBAU negative n (%)	Total number n (%)	x^2	OR (95% CI)	*p* value
Gender						
Female	25 (67.6)	12 (32.4)	37 (48.1)	0.2049	1.389 (0.5452-3538)	0.6508
Male	24 (60.0)	16 (40.0)	40 (51.9)			
Place of résidence						
Urban	28 (58.3)	20 (41.7)	48 (62.3)	1.562	-	0.4579
Semi-urban	18 (72.0)	7 (28.0)	25 (32.5)			
Rural	3 (75.0)	1 (25.0)	4 (5.2)			
Bladder catheter						
Yes	44 (67.7)	21 (32.3)	65 (84.4)	1.947	2.933 (0.8319-10.343)	0.1629
No	**5 (41.7)	7 (58.3)	12 (15.6)			
Current antibiotic therapy						
Yes	31 (53.4)	27 (46.6)	58 (75.3)	8.835	0.06379 (0.008-0.5102)	0.003*
No	18 (94.7)	1 (5.3)	19 (24.7)			

CBAU = cytobacteriological analysis of urine; OR=Odds ratio; CI=Confidence interval; * = statistically significant at $p<0.05$; ** = Two patients had significant bacteriuria but no leukocyturia (no UTI)

Table 2: Analysis of risk factors for urinary tract infections among hospitalized study participants at the nephrology and haemodialysis department of Bogodogo University Teaching Hospital Ouagadougou, Burkina Faso

Risk factors	**CBAU positive n (%)**	**CBAU négative n (%)**	**Total n (%)**	**OR (95% CI)**	***p* value**
Male gender	24 (60.0)	16 (40.0)	40 (52)	0.72 (0.2826-1.834)	0.6359
Pregnancy	4 (57.1)	3 (42.9)	7 (9.09)	0.74 (0.1533-3.579)	0.7003
GFR<30mL/min/1.73m2	25 (55.6)	20 (44.4)	45 (58.4)	0.42 (0.1543-1.125)	0.0966
Age>75 years	2 (10.0)	18 (90.0)	20 (25.9)	0.02 (0.0047-0.1186)	<0.0001*
Age>65 years with at least three frailty criteria	6 (40.0)	9 (60.0)	15 (19.4)	0.29 (0.0918-0.9452)	0.0417*

CBAU = cytobacteriological examination of urine; OR=Odds ratio; CI=Confidence interval; * = statistically significant at $p<0.05$

Frequency of isolated microbial pathogens:

Of the urine samples analyzed for the 77 participants, 56 microbial pathogens were isolated from 49 participants with positive CBAU. Of the 49 CBAU positive participants, 9 (18.4%) had two microbial pathogens isolated from their urine samples. The *Enterobacterales* represented 58.9% (n=33), including 39.4% *Escherichia coli* (n=13), 36.4% *Klebsiella* spp (n=12) and 9.0% *Serratia* spp (n=3). Non-fermentative Gram-negative bacilli represented 7.1% (n=4), with 3 cases (5.4%) of *Acinetobacter baumannii* and 1 (1.8%) of *Pseudomonas aeruginosa*. *Staphylococcus aureus* was isolated in 3 (5.4%) samples. *Candida* was isolated in 16 (28.6%) cases.

Table 3: Frequency of isolated microbial pathogens of urinary tract infections among hospitalized study participants at the nephrology and haemodialysis department of Bogodogo University Teaching Hospital Ouagadougou, Burkina Faso

Order/Family	**Species**	**Number (%)**
Saccharomycetaceae	*Candida* spp	16 (28.6)
Staphylococcaceae	*Staphylococcus aureus*	3 (5.4)
Enterobacterales	*Escherichia coli*	13 (23.2)
	Klebsiella pneumoniae	11 (19.6)
	Klebsiella oxytoca	1 (1.8)
	Proteus mirabilis	1 (1.8)
	Serratia odorifera	3 (5.4)
	Enterobacter cloacae	1 (1.8)
	Citrobacter koseri	2 (3.6)
	Cedecea lapagei	1 (1.8)
Pseudomonadales	*Acinetobacter baumannii*	3 (5.4)
	Pseudomonas aeruginosa	1 (1.8)

Table 4: Antimicrobial resistance of isolated bacterial pathogens of urinary tract infections among hospitalized study participants at the nephrology and haemodialysis department of Bogodogo University Teaching Hospital Ouagadougou, Burkina Faso

Antimicrobials/Bacteria	***E. coli* (%) (n=13)**	***Klebsiella* spp (%) n=12)**	***Serratia* spp (%) (n=3)**	***Citrobacter koseri* (%) (n=2)**	***Enterobacter cloacae* (%) (n=1)**	***Proteus mirabilis* (%) (n=1)**	***Cedecea lapagei* (%) (n=1)**
Ampicillin	13 (100)	12 (100.0)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Amoxicillin-Clavulanic acid	12 (92.3)	11 (91.6)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Piperacillin-Tazobactam	5 (38.4)	6 (0.5)	3 (100.0)	1 (50.0)	1 (100.0)	0	1 (100.0)
Cefadroxil	12 (92.3)	12 (100.0)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Cefoxitin	11 (84.6)	10 (83.3)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Ceftazidime	10 (76.9)	12 (100.0)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Cefotaxime	10 (76.9)	10 (83.3)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Cefepime	10 (76.9)	9 (75.0)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Imipenem	0	4 (33.3)	0	0	1 (100.0)	0	1 (100.0)
Ciprofloxacin	9 (69.2)	8 (66.7)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Levofloxacin	9 (69.2)	8 (66.7)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)
Gentamycin	3 (23.0)	9 (75.0)	2 (66.6)	2 (100.0)	1 (100.0)	0	1 (100.0)
Amikacin	0	3 (25.0)	2 (66.7)	0	0	0	0
Tobramycin	3 (23.0)	9 (75.0)	3 (100.0)	2 (100.0)	1 (100.0)	0	1 (100.0)
Sulfamethoxazole-trimethoprim	9 (69.2)	11 (91.6)	3 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)

All the 3 (100.0%) *S. aureus* isolates were resistant to penicillin, 2 (66.7%) of the 3 were resistant to cefoxitin (i. e. MRSA) and 1 (33.3%) was resistant to imipenem. Amikacin and gentamicin were inactive on all 3 *S. aureus* isolates. The susceptibility profile of the *Enterobacterales* isolates to amikacin was 84.8% (28/33), with 40.0% (13/33) for *E. coli,* 27.2% (9/33) for *Klebsiella* spp and 3.0% (1/33) for *Serratia* spp. Amikacin was active on 100% of *E. coli*, 75% (9/12) of *Klebsiella* spp and 33.3% (1/3) of *Serratia* spp. The susceptibility of the *Enterobacterales* to imipenem was 81.8% (27/33) with 40.0% for *E. coli* and 24.2% (8/33) for *Klebsiella* spp. Imipenem was active on 100% of *E. coli* and *Serratia* spp and 66.7% (8/12) of *Klebsiella* spp. The 3 (100%) strains of *Serratia* spp were sensitive to this antibiotic.

Resistance of the *Enterobacterales* to ciprofloxacin and levofloxacin was 75.7% (25/33) for each of these antibiotics. *Escherichia coli* and *Klebsiella spp* isolates were resistant to these 2 antibiotics with 76.9% (10/13) and 66.7% (8/12) respectively. All isolated strains (100%) of *Serratia* spp, *Citrobacter koseri, Enterobacter cloacae, Proteus mirabilis* and *Cedecea lapagei* were resistant to these 2 antibiotics. For cefotaxime and ceftazidime, the Enterobacterales were resistant to them in 84.9% and 90.9% respectively.

Of all the strains isolated, 20 (35.7%) were multi-resistant bacteria. Among the 18 (32.1%) bacteria producing extended spectrum β-lactamases (ESBL), there were 17 *Enterobacterales* (i. e. 30.3% of isolated strains and 51.5% *Enterobacterales*) including 61.5% (8/13) *E. coli*, 58.3% (7/12) *Klebsiella* spp, and 66.6% (2/3) *Serratia* spp. Regarding non-fermentative Gram-negative bacilli, *Acinetobacter baumannii* and *Pseudomonas aeruginosa* were isolated in four patients, i.e. in 7.1% of cases. All 3 (100.0%) *A. baumannii* isolates and 1 (100.0%) *P. aeruginosa* strain were susceptible to amikacin and gentamicin. The 3 strains of *A. baumannii* isolated were all resistant to cefixime and ceftazidime. Among the yeasts isolated, resistance to antifungals was 93.8% for amphotericin B and 62.5% for miconazole but the strains were sensitive to clotrimazole (75.0%) and nystatin (62.5%).

Discussion:

In this study, the male gender was predominant (51.9%), the majority of patients resided in urban areas (62.34%) and impaired renal function was the first reason for consultation (55.8%). The study reported a high frequency of UTI in hospitalized patients i. e. 61.0% of patients in whom cytobacteriological analysis (CBAU) was performed. This observation could be linked to the presence of high representation (more than 84.4%) of patients hospitalized with permanent urinary catheters. The presence of this device in the patient is the primary risk factor for UTI. It is indicated in situations of urinary disorders or for monitoring diuresis (12,13). During hospitalization, its presence promotes colonization of the urinary tract by pathogens from the hospital environment. The prevalence of positive CBAU was slightly higher in the female participants (67.7%) compared to the male participants (60.0%). Although the prevalence difference was not statistically significant (p=0.6508), it has been reported in the literature that women are at higher risk of UTI and that 50.0% of them experience a UTI episode during their life time (14).

Our study reported 27.3% of UTI in patients with CKD. The high frequency of infections in these fragile patients subjected to numerous invasive maneuvers such as extrarenal purification by hemodialysis (6) was also reported in the study by Some (15) in 2016 in the nephrology and hemodialysis department of CHU-YO, where 42.5% of patients with kidney failure had had at least one hemodialysis session. This is a purification process that takes place outside the body using an artificial membrane and using a central catheter which is very often the starting point of the infection

Among the pathogens isolated, *Entero bacterales* were the most incriminated in 58.9%, and *E. coli* and *Klebsiella* spp were the predominant species. These results are similar to the literature data which reported that these two bacteria are the main pathogens involved in UTI (7,11,16,17). Indeed, *E. coli* is an intestinal bacteria flora of mammals, that is very common in humans, and constitutes approximately 80% of the aerobic intestinal flora (18). *Klebsiella* are ubiquitous bacteria, present in the digestive tract and in the respiratory system of mammals, including humans, as commensal bacteria. They are called opportunistic because they very often cause infections when certain conditions are met, such as weakened immune system, surgical procedures, catheterization and the presence of a permanent urinary catheter. This leads to invasion of organs which could lead to sepsis, infection of the urinary tract or respiratory system (19). Ascending contamination is most common in UTIs. Indeed, pathogens of faecal origin coming from the perineal region get into the bladder, especially in women. This origin could explain the frequency of *Enterobacterales* in episodes of UTI.

Concerning the resistance profiles of the

isolated pathogens, imipenem, amikacin and gentamicin were the most active antibiotics *invitro*. Kafando (20) and Habou (21) reported 97.0% and 65.0% *in vitro* activity respectively for imipenem and amikacin on isolated pathogens. High resistance of the *Enterobacterales* to the fluoroquinolones (75.7%) and sulfonamides (84.8%) was noted in the present study. Other researchers such as Habou (21) reported in 2019 a resistance of 59.4% to fluoroquinolones and 62.1% to sulfonamides. The emergence of resistance of pathogens to these commonly used antibiotics, due to their easy accessibility, could be linked to their current abusive and inappropriate consumption, and to their being prescri bed as empirical antibiotic therapy most of the time. The most used antibiotic molecules were ciprofloxacin, cotrimoxazole, amoxicillin-clavulanic acid, ceftriaxone, cefotaxime, cefixime, lincomycin and metronidazole. Our study found a significant association between prevalence of UTI and antibiotic use, with frequency of positive CBAU lower in patients on antibiotics (53.4%) compared to patients who were not on antibiotics (94.7%) (OR=0.064, 95% CI=0.0008-0.5102, p=0.003). Majority of the study participants in our study were patients with chronic kidney disease, and therefore immunocompromised. Appropriate intake of antibiotics could reduce infections in this vulnerable population.

Of the 56 pathogens isolated, 20 (35.7%) were multi-drug resistant bacteria, 10.0% of which were due to methicillin-resistant *Staphylococcus aureus* (MRSA), and 90.0% with extended-spectrum β-lactamase (ESBL)-producing bacteria. This observation is in line with data from the literature, which reports the involvement of multi-drug resistant bacteria in 35.8% of UTIs in West Africa (22). This high prevalence of ESBL in *E. coli* and *Klebsiella* agrees with data from an observational study carried out by the University of Versailles Saint-Quentin-en Yvelines and the Pasteur Institute of Paris and which reported that 90.0% of cases of transmission of ESBL-producing *K. pneumoniae* to new patients could be explained by direct or indirect contact with infected patients compared to less than 60.0% for ESBL-producing *E. coli* (23). These results indicate that prevention strategies primarily focused on hand hygiene can effectively limit the transmission of these ESBL-producing bacteria. However, other measures such as environmental decontamination, and rational/documented use of antibiotics, may be necessary to prevent their emergence and spread.

High resistance of *Candida* spp to amphotericin B and miconazole will greatly hamper patient care because there are only a few antifungal drugs available (24). Exposure to drugs in the form of prophylaxis, repeated or long-term treatment, the presence of a permanent urinary catheter or central catheter, poor compliance with treatment regimens, could be associated with the emergence of this resistance (41, 70,72). Free access to antifungals, particularly imidazoles, within our pharmaceutical stores, facilitates the routine use of self-medication by patients for the management of vaginal candidiasis and skin mycoses.

Conclusion:

Urinary tract infection was identified in more than half of patients hospitalized in the nephrology-haemodialysis department of CHUB. These patients, mainly suffering from CKD, are subject to numerous invasive maneuvers and a long hospitalization stay, favoring their infection by pathogens from the hospital environment. The emergence of multi-drug resistant bacteria to antibiotics constitutes a cause of real therapeutic impasse, especially since it occurs in a hospital environment in which these bacteria are involved in most healthcare-associated UTIs. Faced with this situation, it is important to strengthen hygiene measures in healthcare environments and promote strict rules of antibiotics prescription, distribution and consumption.

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Contributions of authors:

KBA and IT conceived the study idea and led the conduct of the study and editing of the manuscript; KBA, DEA and TJR were responsible for carrying out the bacteriological diagnostic activities; KAB and KAY were responsible for English translation activities; and KAB, IT, DEA, TJR, KAY, SM, and SI were responsible for the final editing of the manuscript. All authors approved the final manuscript submitted for publication.

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