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## Diversity and antibiotic resistance profile of enterobacterial species isolated from urinary tract infections at the China-Guinea friendship hospital of Kipé/Conakry

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### Abstract

**Introduction:** Enterobacteriaceae remain a family which include a bacterial species amongst the most frequently associated to urinary tract infections. The aim of this study was to determine the frequency and the antibiotic resistance profile of Enterobacteria isolated from urinary tract infections.

**Materials and Methods:** This prospective study was carried out from January 20<sup>th</sup> to July 20<sup>th</sup>, 2020 at China-Guinea Friendship Hospital of Kipé in Conakry. One hundred and sixty-one patients were studied.

**Results:** Female sex was predominant (62.73%) and the sex ratio (M/F) was 0.59. The most important age group was 51 years and over (62.25%). Fifteen species were identified. The most frequently isolated species were *Klebsiella pneumonia* (32.30%), *Escherichia coli* (27.95%), *Enterobacter cloacae* (9.94%) and *Serratia odorifera* (5.59%).

**Conclusion:** The majority of these strains were resistant to tetracycline, Trimethoprim/Sulfamethoxazole, and cephalosporins. On the other hand, the carbapenems (imipenem and meropenem) were active on the majority of strains.

**Keywords:** Multi-drug- resistance, antibiotics, enterobacteriaceae, Conakry/Guinea

### Introduction

Enterobacteriaceae are a commensal bacterium of the digestive tract frequently responsible for community-acquired and nosocomial infections such as urinary tract infections. Urinary Tract Infections (UTI) constitute serious health problems affecting all ages and sexes [1-3]. However, they are the most common bacterial infections in the community, regardless of age. They are generally benign and the infection is limited to the lower urinary tract, requiring simple antibiotic treatment. However, recurrences are common and can evolve into an upper urinary tract infection requiring heavier antibiotic treatment and more extensive management [1]. Bishop *et al.* in 2004 reported in their study that *Escherichia coli* is the most prevalent uropathogen in patients with UTI, both in the community and in hospitals [2-5]. Studies carried out in many regions of the world report high resistance of amoxicillin to *Escherichia coli* with frequencies of: 43.4% in North America [6] 48.3% in Europe [7], in the African countries and developing Asian countries, resistance frequencies can reach 80% [8, 9,10, 11]. In America, a study carried out in Chicago revealed that Enterobacteriaceae were the main causes of urinary tract infections (88%) [13].

In Morocco Koné *et al.* reports in their study published in 2016 that Enterobacteriaceae were the main bacteria isolated with a prevalence of 79% of which *Escherichia coli* represented 53.2%, *Klebsiella pneumonia* (28%), *E. cloacae* (7.8%) and *P. mirabilis* (7%), beta-lactamase producers accounted for 17.5% [4]. In the Democratic Republic of Congo Leonid *et al.* in their study in 2014 reported that Enterobacteriaceae were the frequently isolated species with a predominance of *Escherichia coli* (58.5%), *Klebsiella* spp. (21.9%) and *Enterobacter* spp. (16.2%) [5]. In Guinea, Makanera *et al.* reported in their study published in 2021 a high resistance of *Escherichia coli* to numerous antibiotics belonging to different families [12]. These authors reported before in 2020 the multi-resistance of *Klebsiella pneumonia* strains to antibiotics belonging to different families [13].

These authors showed that 54% of the *Klebsiella pneumoniae* strains studied were producers of extended-spectrum Beta-lactamases (ESBL). Also 15% of the strains produced ESBL with impermeability to cephamycins.

The objective of this study was to identify the different species of Enterobacteriaceae isolated from urinary tract infections at the Sino-Guinean Friendship Hospital (HASIGUI) as well as their resistance to antibiotics from January 20 to July 20, 2020.

### Materials and Methods

The study involved all urine samples containing Enterobacteriaceae strains received during our study period at the HASIGUI Biomedical Laboratory.

Bacterial cultures were made on different agar media: Mac Conkey agar (Biomérieux, Marcy l'Etoile, France) and CLED agar (Biomérieux, Marcy l'Etoile, France). Uniform bacterial colonies isolated from the cultures were stained by Gram's Method in order to check their purity, a key step before analyzing using the Vitek 2 Compact 15 machine (Biomérieux, Marcy l'Etoile, France). Bacterial identification and antibiograms were performed using the classic method (API 20 E and API ATB gallery) and the Vitek 2 compact 15 automaton (Biomérieux, Marcy l'Etoile, France). Vitek 2 GN cards were used for identification and Vitek 2 AST-N 233 cards (Biomérieux, Marcy l'Etoile, France) were used to carry out antibiograms following the manufacturer's instructions (Biomérieux, Marcy l'Etoile, France). Ready-to-use Vitek 2 GN cards contain 64 wells corresponding to 64 reactions allowing the identification of Gram-negative bacilli (Enterobacteriaceae, Non-Enterobacteriaceae and highly pathogenic germs). Ready-to-use Vitek 2 AST-N 233 Cards containing 18 antibiotics and combinations of antibiotics belonging to different families are intended for both fermentative and non-fermentative Gram-negative bacteria. These antibiotics are: ampicillin, amoxicillin/clavulanic acid combination, ticarcillin, piperacillin/tazobactam combination, cephalothin, cefoxitin, cefotaxime, ceftazidime, imipenem, ertapenem, amikacin, gentamicin, tobramycin, nalidixic acid, ciprofloxacin, ofloxacin, nitrofurantoin, and Trimethoprim/Sulfamethoxazole.

### Results

A total of 161 strains of Enterobacteriaceae were isolated from an equivalent number of patients at the HASIGUI Biomedical Laboratory (LBM) from January 20 to July 20, 2020. The Cardiology department represented the highest rate with 32.92% followed by Emergencies 21.12% (Table 1).

**Table 1:** Distribution of different isolates of Enterobacteriaceae according to the Requesting Departments (N=161)

Requesting Department	Number	Percentage
Cardiologie	53	32,92
Emergency	34	21,12
Visceral surgery	27	16,77
Externe	23	14,29
Neurology	22	13,66
Traumatology	1	0,62
Neurosurgery	1	0,62

Out of a total of 161 strains of Enterobacteriaceae were isolated from an equivalent number of patients at the

HASIGUI Biomedical Laboratory (LBM) from January 20 to July 20, 2020. The age group 51 years and over was predominant with a rate. The average age of the patients was 55.39±19 years [1 year-90 years]. The female sex was predominant with a sex ratio (M/F) = 0.59. According to professions, housewives were predominant (30.43%), followed by Merchants (19.25%). The majority of patients (49.69%) came from the town of Ratoma. (Table 2).

**Table 3:** Socio-demographic characteristics

characteristics	Number (N=161)	%
<b>Age (years)</b>		
1 à 14	4	2.48
14 à 25	11	6.83
26 à 50	41	25.47
≥51	105	65.22
Mean age 55,39 ± 19 years		
Extremes [1 – 97 years]		
<b>Sex</b>		
Male	60	37.27
Female	101	62.73
<b>Profession</b>		
Housekeepers	49	30.43
Trader/Merchant	31	19.25%
Students	13	8.07%
Teachers	10	6.21%
workers	4	2.48%
Driver	1	0.62%
Administration officers	26	16.14%
Farmers	17	10.55%
Not Applied	5	3.10%
Health workers	5	3.10%
<b>Origin (Different Municipalities of Conakry)</b>		
Ratoma	80	49.69%
Matoto	28	17.39%
Dixinn	15	9.32%
Matam	7	4.35%
Kaloum	1	0.62%
Outside of Conakry	30	18.63%

Thus, fifteen (15) different species of Enterobacteriaceae were identified with a majority of the species *Klebsiella pneumoniae* (32.30%), followed by *Escherichia coli* (27.95%) and *Enterobacter cloacae* (9.94%) (Table 3).

**Table 3:** Frequencies of different enterobacterial species isolated at China-Guinea friendship of Kipé in Conakry (N=161)

Bacterial species	Number	Percentage
<i>Klebsiella pneumoniae</i>	52	32.30
<i>Escherichia coli</i>	45	27.95
<i>Enterobacter cloacae</i>	16	9.94
<i>Serratia odorifera</i>	9	5.59
<i>Klebsiella oxytoca</i>	6	3.73
<i>Enterobacter aerogenes</i>	4	2.48
<i>Serratia liquefaciens</i>	3	1.86
<i>Serratia plymuthica</i>	2	1.24
<i>Citrobacter freundii</i>	7	4.35
<i>Citrobacter braakii</i>	2	1.24
<i>Citrobacter koseri</i>	2	1.24
<i>Raoultella terrigena</i>	4	2.48
<i>Raoultella Ornithinolytica</i>	3	1.86
<i>Raoultella planticola</i>	3	1.86
<i>Proteus mirabilis</i>	3	1.86

**Table 4:** Resistance profile of different species of Enterobacteriaceae strains isolated from patients received at HASIGUI.

ATB	S (%)	I(%)	R(%)	Total
Ampicillin	1(0.76)	0(0.00)	130 (99.23)	131
Amoxicillin/Clavulanic Acid	32(24.80)	2(1.52)	95(73.64)	129
Ticarcillin	7(5.55)	0(0.00)	129(94.85)	136
Piperacillin	10(8.36)	0(0.00)	111(91.73)	121
Piperacillin/Tazobactam	75(50.67)	22(14.86)	51(34.45)	148
Cephalothin	18(13.43)	2(1.49)	114(85.07)	134
Céfoxitin	66(44.29)	1(0.67)	82(55.03)	149
Ceftazidime	41(27.70)	16(10.81)	91(61.48)	148
Cefuroxime	28(19.31)	2(1.37)	115(79.31)	145
Cefotaxime	33(22)	3(2.00)	114(76)	150
Cefixime	4(3.80)	15(14.28)	86(81.90)	105
Cefepime	35(24.30)	28(19.44)	81(56.25)	144
Nitrofurantoin	37(56.06)	5(7.57)	24(36.36)	66
Imipenem	114(78.08)	5(3.42)	27(18.49)	146
Meropenem	94(74.01)	3(2.36)	30(23.62)	127
Amikacin	81(57.85)	4(2.85)	55(39.28)	140
Gentamicin	54(34.83)	6(3.87)	95(61.29)	155
Tobramycin	51(33.77)	11(7.28)	89(58.94)	151
Nalidixic Acid	42(28.37)	9(6.08)	97(65.54)	148
Ciprofloxacin	50(35.46)	9(6.38)	82(58.15)	141
Ofloxacin	42(26.92)	4(2.56)	110(70.51)	156
Fosfomicin	72(50.34)	1(0.69)	70(48.95)	143
Trimethoprim/Sulfamethoxazole	26(18.18)	2(1.39)	115(80.41)	143
Levofloxacin	66(42.03)	6(3.82)	85(54.14)	157
Tetracycline	11(7.80)	1(0.70)	129(91.48)	141

S: Sensitivity; I: Intermediate, R: Resistance

## Discussion

This study was carried out on a total of 161 Enterobacteriaceae strains isolated at the Sino-Guinean Friendship Hospital in Kipé/Conakry from January 20, 2020 to July 20, 2020.

It appears from this study that 62.73% of patients were female and 37.27% male with a sex ratio (M/F) of 0.59 in favor of women. Our results are similar to those found by Amet Dia Y., in 2014 in Senegal (Dakar), who found 68, 17% female and 31, 83% male patients [14]. The most represented socio-professional category was that of housewives, i.e. 30.43%, followed by traders (19.25%) and administrative officers (16.14%). The predominance of housewives could be explained by the fact that not only the majority of the Guinean population is represented by the female sex but especially by the fact that all patients without qualifications often put themselves in the category of housewives. The distribution according to origin showed that the majority of patients (81.37) were from the city of Conakry, and particularly from the commune of Ratoma (49.69%) housing the Hospital (HASIGUI), followed by that of Matoto (17.39%). The high attendance rate by the populations of these two municipalities could be explained by the proximity of this hospital to users. In our study, the distribution of patients in the HASIGUI consultation services showed that 32.92% were cardiology, followed by emergencies with 21.12%, visceral surgery with 16.77%. The high frequency of isolation of Enterobacteriaceae strains in patients in the cardiology department is partly due to the fact that there are high requests for bacteriological examinations (particularly ECBU). Indeed, Makanera *et al.* in their study conducted in 2017 at HASIGUI had noted that requests for bacteriological examinations from the

Cardiology department represent 41.36% of all bacteriological examinations carried out at the HASIGUI Biomedical Laboratory [15].

However, we note that 16.77% of the patients came from the service of other hospitals and health structures in the city of Conakry and from the interior of the country. This high rate of outpatients at HASIGUI is due to the fact that the HASIGUI biomedical laboratory is considered to be the best equipped in the country since it opened in 2012. Consequently, the quality of the analysis results is better there. This observation was made by external quality competition of the biomedical laboratories of Guinea with the Agency One world Accuracy (Canada) operating at the global level. In our study, bacterial identification made it possible to determine 15 species of Enterobacteriaceae with *Klebsiella pneumonia* as the majority species (32.30%), followed by *Escherichia coli* (27.95%), *Enterobacter cloacae* and *Serratia odorifera* which corresponded respectively at 9.94% and 5.59% of the total cash. Our results are partly similar to those reported by Tejiogni A *et al.* in their studies in 2015 in which *Escherichia coli* ranks first with 27.82% followed by *Klebsiella Pneumonia* 19.55% and *Enterobacter cloacae* 7.52% [16].

It appears in our study an increased resistance to certain betalactamines of a large number of strains of Enterobacteriaceae such as ticarcillin, piperacillin, ampicillin and cefalotin this high resistance could be explained by the fact that a good number of Isolated Enterobacteriaceae have natural resistance to these antibiotics.

ESBLs represent a major threat among multidrug-resistant bacterial isolates. They have been increasingly described worldwide since their description in the early 1980s and have risen to prominence among Enterobacteriaceae isolates in nearly world wide, now not only in the nosocomial but also in the community setting [16]. These results showed that ESBL-producing Enterobacteriaceae are a large problem in African healthcare institutions and communities.

However, several of our strains of Enterobacteriaceae showed great resistance to tetracycline, to the Trimethoprim/Sulfamethoxazole association and to cephalosporins. These results are partly similar to those of Farkas *et al.* who found in their study in 2019 a strong resistance of Enterobacteriaceae to the 74% Trimethoprim/Sulfamethoxazole combination and to Cephalosporins such as: Ceftazidime 83%, Cefepime 76% and cefuroxime 64% [17]. Most of these species were sensitive to Meropeneme, imipenem and amikacin. These results are different from those of Kalambray *et al.* who reported in their study that 100% of Enterobacteriaceae species were sensitive to imipenem [18].

## Conclusion

Enterobacteriaceae are germs responsible for a large part of urinary tract infections which are sometimes dreadful. In recent years, anarchic antibiotic therapy has led to the appearance of bacteria that are multi-resistant to antibiotics. The increase in this resistance must be monitored, especially in the hospital environment.

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**Conflicts of interests**

The authors declare that they have no conflicts of interests.

**Statement of informed consent**

The informed consent of the patient to participate in the study was acquired and confidentiality was observed throughout the data collection process. The results were used for strictly scientific purposes.

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