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Bacterial Ecology and Bacterial Resistance Profile to Antibiotics in the Department of Medicine and Urology of the BSS University Hospital of Kati

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ABSTRACT

Background: *The emergence and spread of antibiotic resistance is a major public health threat. Worldwide, one of the main causes remains the unreasonable use of antibiotics.*

Objective: *To map bacterial infections and the resistances profile of antibacterials at Kati University Hospital.*

Methodology: *Transversal analytical study with prospective collection over a period of 20 months in the department of general medicine and urology of the BSS University Hospital of Kati.*

Results: *102 patients participated in this study with an average age of 55.5 years. Almost a quarter (72.5%) of participants were men. Less than half were patients aged 60 years. The biologics examined involved urine (78.4 %), pus (16%), blood (12.7%), stool (2%) samples. The main germs isolated were: Escherichia coli (52.9%); Klebsiella pneumonia (14.5%); Staphylococcus aureus (9.9%); Acinetobacter baumannii and Enteroccocus faecium (4.9%). The level of resistance of Escherichia coli and Klebsiella pneumoniae was high to ampicillin, amoxicillin-clavulanic acid; cotrimoxazole; moderately elevated to C3G, and fluoroquinolones with relative sensitivity to aminoglycosides. Imifpenem, Amikacin, Ertapenème were the most active antibiotics. Staphylococci were resistant to penicillin, with ciprofloxacin and oxacillin. Thus, Acinetobacter baumannii had a high level of resistance to C3G, Ticarcillin, Cotrimoxazole and Piperacillin-tazobactam. Enteroccocus faecium had strong resistance to Cotrimoxazole and Ciprofloxacin.*

Approximately, 51% of isolated bacteria were multi-resistant. HIV infection; antibiotic therapy; a long stay in a healthcare setting is a risk of acquiring multidrug resistance. This relationship is statistically significant with a p value of p<0.00respectively 5

Conclusion: *The level of resistance recorded should serve as an alert for the implementation and application of prevention strategies for BMR. The resistance profile determined will be used to better guide the rational prescription of antibiotic therapy in our hospital.*

Keywords
Bacterial ecology, Antibacterial resistance profile, CHU BSS Kati.

Introduction
The discovery of antibiotics was considered the most important and astonishing of the twentieth century. Their introduction into clinical care practice is one of the interventions that has addressed not only infectious disease control challenges with millions of lives saved but also a revolutionized practice [1]. However, according to the WHO, a serious and growing threat to global health is deteriorating the effectiveness of these therapeutic molecules, due to the increase in antibiotic resistance in community care settings and the environment concomitant with their use [2]. This Bacterial Resistance to Antibiotics, defined here as the ability of bacteria to survive in concentrations of antibiotics that usually inhibit/kill others of the same species "Antimicrobial resistance may not seem as urgent as a pandemic, but it is just as dangerous" [3]. The European Antibiotic Resistance Surveillance Network (EARSS) reports about 50% of *Escherichia coli* strains were resistant to ampicillin in France, as globally in all AERSS participating countries [4].

It affects 500,000 people with suspected bacterial infections in 22 countries and according to the same source, more than 700,000 deaths worldwide result each year from antimicrobial-resistant infections based on OMS, more than the number of deaths caused by cancer by 2050 [5].

In the United States, resistance to ATBs is responsible for more than 23,000 deaths and a direct societal cost of $20 billion, and an indirect cost of $35 billion. It is noted during 400,000 infections responsible per year with at least 25,000 deaths [5,6].

In Africa, this phenomenon of resistance is poorly evaluated; data show a strong spread of multidrug-resistant bacteria in the various countries of West Africa [6]. The lack of national epidemiological data on Bactriean resistance and of national reference on BMR are a handicap to the implementation of BMR prevention strategies [1]. Plot work in the context of the LCRMs reports a high frequency of multidrug-resistant enterobacteriaceae among others, 64.3% of *E coli* and 34.5% of *Klebsiella pneumonia* [1,5]. Within other hospitals in the country, ours would not be immune to the emergence of antibacterial resistance. It is necessary to take stock of the issue of the profile of antibacterial resistance, with regard to abusive and unregulated prescription; The absence of a local repository; the frequency of invasive procedures and the long stay of patients in a care setting.

Our objective was to do bacterial infectious etiological research of cases; determine the frequency of the current bacterial resistance profile and write the determinants associated with the emergence of antibacterial resistance.

Methodology
It is analytical cross-sectional study using a prospective collection method over a period of 20 months (January 2019 to August2020) in the Department of General Medicine and urologsurgery within the University Hospital Center “Professor Bocar Sidy Sall" (CHU-BSS) by Kati. Our study site is located about fifteen km from the capital of the country and approved for the care of patients referred from different levels of the country's health pyramid or from those who have come for routine consultations by personal decision.

Study Population Characteristics
Adult patients admitted to hospitalization following referral from a health facility of lower technical platform level or equivalent level, having been exposed to antibiotic therapy or not; or patients who have made an individual decision of outpatient consultation prior to hospitalization.

Eligibility
Eligibility for the study concerned exhaustively all patients admitted to hospitalization with clinical signs in favor of an infectious syndrome who had benefited from a collection of pathological products for etiological research purposes and whose bacterial etiology documented is combined with an antibiogram over the entire study period.

Data collection and analysis
Data collection is carried out by pre-trained and field-tested survey personnel. The data is collected on pre-established individual records and entered on Access version 2016. The variables studied include sociodemographic, clinical, biological bacteriological variables. The premium IMB SPSS Statistics 21 software was used for the analysis. The proportions were compared by the chi-square test and Fisher's exact test. A p-value ≤ 0.05 was considered a statistically significant difference.

Ethical aspects
The protocol of this study was submitted to the administrative managers of the CHU " Professor Bocar Sidy Sall" of Kati. After approval, patients' voluntary, voluntary and informed consent was sought prior to inclusion. All patients have an identification number that will allow them to remain anonymous. The files are closed in a safe and kept for a period of 5 years.

Results
Socio-demographic characteristics of participants
During the study period, we collected 840 hospitalizations, 102 patients meeting our inclusion criteria or 12.14% of patients. Most

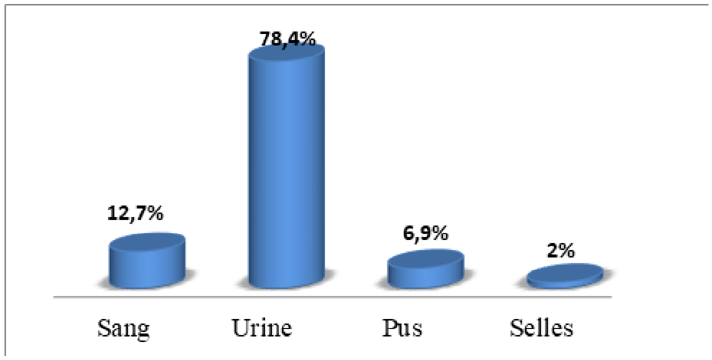


Figure 1: Sample portion taken.

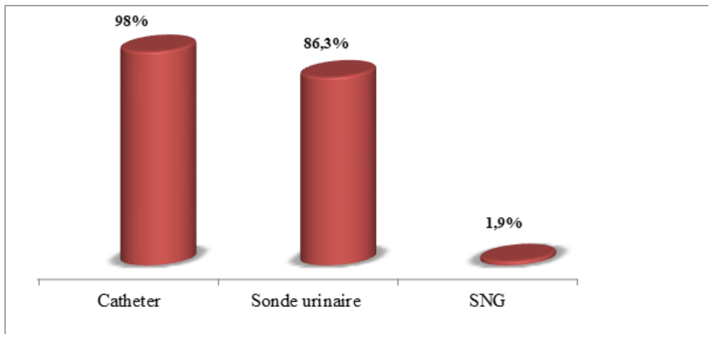


Figure 2: Distribution by wearing of medical equipment.

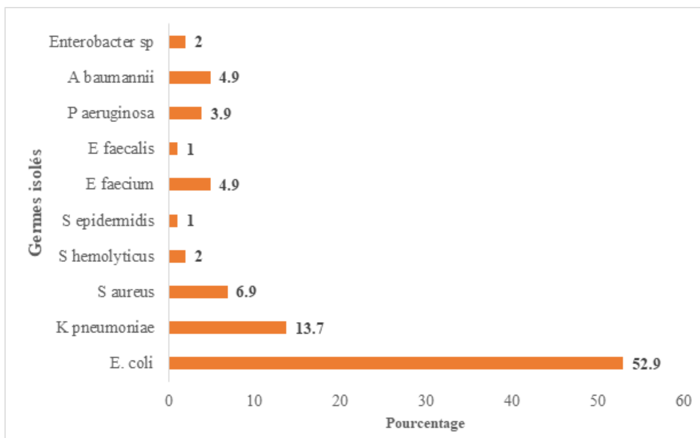
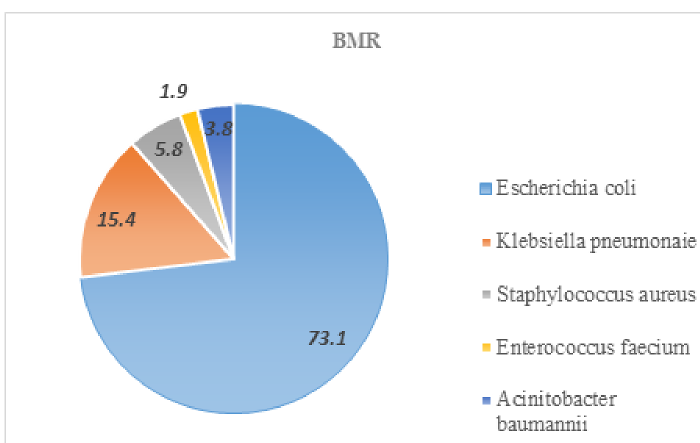


Figure 3: Type of germs isolated.



ZETTI: 30.1% BMR

58.5% of *Escherichia coli*,

34.0% ***Klebsiella pneumoniae***

Faye N: 33.6% BMR

Enterobacteriaceae 38.8% +++

Figure 4: Proportion of different multidrug-resistant bacteria in isolates.

Table 1: Proportion of germs isolated by body fluids.

Bacterium	Blood (%)	Urine (%)	Stool (%)	Pus (%)	Total
Escherichia Coli	3	46	1	4	54
Klebsiella pneumoniae	2	12	0	0	14
Staphylococcus aureus	2	4	0	1	7
Streptococcus hemolyticus	2	0	0	0	2
Streptococcus epidermis	1	0	0	0	1
Enterrococcus faecium	0	5	0	0	5
Enterococcus faecalis	0	1	0	0	1
Pseudomonas aerguinosa	0	4	0	0	4
Acinetobacter baumani	0	5	0	0	5
Enterobacter sp	0	2	0	0	2
Morganella morganii	0	1	0	0	1
Salmonella spp	0	0	1	0	1
Proteus mirabilis	0	1	0	0	1
Sphingomonas	0	1	0	0	1
Raoultella ornithinolytica	0	1	0	0	1
Proteus penneri	0	1	0	0	1
Streptoccocus spp	0	0	0	1	1
Total	**10**	**84**	**2**	**6**	**102**

Table 2: Profile resistance *Escherichia coli* to antibacterial.

Antibiotic	Sensitive n %	Resistant n %	Total n %
Ampicillin	2 (3,7)	**48 (88,9)**	50 (92,6)
Amoxi-Ac clavulanic	7 (13)	**44 (81,5)**	51 (94,5)
Ticarcillin	3 (5,6)	**39 (72,2)**	42 (77,8)
Piperacillin-Tazobactam	7 (13)	32 (59,3)	39 (72,3)
Cefotaxime	10 (18,5)	39 (72,2)	49 (90,7)
Ceftazidime	8 (14,8)	38 (70,4)	46 (85,2)
Ertapenem	40 (74,1)	**5 (9,4)**	45 (83,3)
Imipenem	45 (83,3)	**2 (3,7)**	47 (87)
Amikacin	41 (75,9)	**9 (16,7)**	50 (92,6)
Gentamicin	27 (50)	20 (37)	47 (87)
Ciprofloxacin	8 (14,8)	42 (64,6)	50 (92,6)
Ofloxacin	4 (7,4)	40 (74,1)	44 (81,5)

Table 3: Resistance profile of *Klebsiella pneumoniae.*

Antibiotic	Sensitive n %	Resistant n %	Total n %
Ampicillin	0	**11 (78,6)**	11 (78,6)
Amoxi-Ac clavulanic	7 (21,4)	**10 (71,4)**	13 (92,8)
Ticarcillin	0	**11 (78,6)**	11 (78,6)
Piperacillin -Tazobactam	3 (21,4)	7 (50)	10 (100)
Cefotaxime	4 (28,6)	7 (50)	11 (78,6)
Ceftazidime	3 (21,4)	**8 (57,1)**	11 (78,6)
Ertapenem	9 (64,3)	**1 (7,1)**	10 (74,4)
Imipenem	11 (78,4)	**2 (14,3)**	13 (92,8)
Amikacin	12 (85,7)	0	12 (85,7)
Gentamicin	3 (21,4)	8 (57,1)	11 (78,6)
Tobramycin	4 (28,6)	8 (57,1)	12 (85,7)
Ciprofloxacin	4 (28,6)	10 (74,4)	14 (100)
Ofloxacin	3 (21,4)	9 (64,3)	12 (85,7)

Table 4: Isolation of bacterial resistance by previous exposure to antibiotic therapy.

		Risk factors related to bacterial resistance			
			95% C.I. for EXP (B)		**P-value**
Step		**Exp (B)**	**Lower**	**Upper**	
	HIV	10,009	3,644	27,493	,000
	ATB	,214	,095	,479	,000
	Constant	,746			,593

of our patients were male and aged 60 years and older with a mean of 55.5 years, a standard deviation of 18, 21 years. More than half of our study population, or 60.8%, had a notion of prior exposure to an antibiotic. The wearing of a noted medical equipment was the peripheral venous catheter in 98% patient and the bladder soundin 86% (Figure 1).

Sampling process

In the 102 subjects collected during the study, the majority biologics were urine (78.4%), Purulent (16%), blood (12.7%), stool (2%) samples that were tested.

E coli is the germ most found in both departments with a greater frequency in the urology department or 53% followed by 14.3% of *Klebsiella pneumonia* and *Staphylococcus aureus* in 7% of cases.

Results of Susceptibility Testing of Priority Germs

Bacterial resistance to antibacterial antibiotics has increased to alarming proportions in view of our analysis.

- *Escherichia coli*: most *E. coli* strains had developed stronger resistance in more than > 60% to ampicillin (88.9%); Amoxicillin-clavulanic acid (81.5%); Ofloxacin (74.1%); Ticarcillin (72.2%). About 40% of the strains were resistant to Cefotaxime Ceftazidime. Ertapenem, Imipenem Amikacin remain active on most strains (only 16% resistance recorded to amikacin).
- *Klebsiella pneumoniae*: 74.4% were resistant to Ciprofloxacin and Tobramycin. All strains tested were sensitive to Amikacin, 7.1% were resistant to Ertapenem and 14.3% to Imopenem.
- *Acinetobacter baumannii*: The combination piperacillin-tazobactam, Ceftazidime and Cotrimoxazole were the most resistant molecules at 60% each. They were all sensitive to Amikacin, the lowest resistance rate was with imipenem 20%.
- *Staphylococcus aureus* had developed a higher resistance to Cotrimoxazole with 57.1% and 42.9% resistance to benzylpenicillin, ciprofloxacin, oxacillin and gentamicin.
- *Enteroccocus spp* had developed resistance to vancomycin and erythromycin (20%); amoxi-clavulanic acid, Cotrimoxazole and Ciprofloxacin (40%).

Multidrug-resistant bacteria (MDR) and associated factors

Multidrug-resistant bacteria accounted for 51% of the germs isolated in our series; ESBL production has been observed in Enterobacteriaceae (*E. coli and K. pneumoniae*). BSLE production was isolated from *E. coli* with a frequency of 73.1% (38 out of 54 strains isolated) followed by15;4% of *K. pneumoniae* Several determinants or factors including HIV infection (40%), previous use of antibiotic therapy (79%) have been identified associated with the emergence of resistance cases but also the duration of hospitalization in a healthcare setting, the average of which was 13.32 days. HIV-infected patients are ten times more likely to have antibiotic resistance to [RR 10,009; 95% C.I. 3.644-27.493] However, we did not find a statistically significant relationship between the use of a bladder catheter and theplacement of a peripheral venous catheter.

The evolution was favorable in patients without BMR carriers, a frequency of 73.1%. The difference was statistically significant ($P<0.05$).

Discussion

The emergence of bacterial resistance with different mechanisms presents a public health problem, as is the case in this study conducted in patients admitted to hospitalization in both departments. The main objective of this study was to investigate bacterial infections and the antibiotic resistance profile. During the implementation of this study, some limitations were identified, including:

- The difference between susceptibility testing is that the samples were not processed in the same laboratory.
- Completeness of data.
- The low participation rate due to lack of financial means for the realization of biological examinations.

Despite these limitations, this study retains its originality, which lies in its prospective and multi-service nature thus taking a picture of the situation of isolated bacteria and their level of sensitivity to antibiotics.

During our study period, 102 patients meeting our inclusion criteria or 12.14% of patients were registered. Most of our patients were male aged 60 years and older with an average age of 55.5 years. This predominance of the elderly and the male sex could be explained by the fact that 2/3 of our patients were collected in the urology department.

Bacterial infection can occur at any age; but it is more common in the elderly because of a decreased immune system, bladder atony, and the presence of comorbidities. In an earlier study conducted in Bamako, the results showed that the infection was more common in women than in men, so he reports in his observation, that the urinary tract infection was not related to age but patients aged 60 years and older were the most affected with and a frequency of 69.23%. The same findings were made in Morocco by Saadoun who in his series also reports that urinary tract infection affects all age groups with a predominance of the age group of 60 years and over (35%), followed by that between 41-60 years (33%) [7]. Indeed, in the elderly, there is a decrease in the immune defenses of the urinary tract due to changes in the urinary tract, especially the bladder and genital tract. These changes vary by gender [8]. Of the 102 samples collected during the study period, they were mainly urine samples (78.4%) followed by blood samples (12.7%), purulent samples (6.9%). Urinary tract infection is the most common bacterial infection in the world. This predominance could be explained using bladder catheters by the majority of our patients (86%). In addition to bladder catheterization, almost all of our patients had undergone peripheral venous catheterization (98.6%) which would be responsible for a probable increase in the rate of bacteraemia. In Morocco, Mortaji had reported in his series that bronchopulmonary infections occupy the first place with a rate of 47%; infections related to blood cultures (primary or secondary bacteremia from another site e.g. urinary tract or catheter) with a rate of about 23%; urinary tract infections with a rate of about 16%; infections related to pus and miscellaneous with a rate of about 9%. Note his study took place in an intensive care unit. For genital swabs, there was a low diagnostic orientation and demand is generally low at the level of national hospitals, which are the last resort for patients after repeated failures of antibiotic therapy.

E coli is the germ most found in both departments (medicine and urology) with a greater frequency in the urology department explaining its presence in most urine samples in this series or 53% followed by *Klebsiella pneumonia* 14.3% and Staphylococcus aureus in 7% of cases. Gram-negative bacilli are mainly responsible for urinary tract infections, hence a significant proportion of *E coli* and *Klebsiella pneumoniae* in our series. This rate is identical to that of Takilt et al. in Algeria in 2014, had found *Escherichia coli* 51.94%, Klebsiella 14.56%, Staphylococcus aureus 2.91% [10]. In Bamako, Coulibaly reports having isolated mostly in order of frequency *Escherichia coli* and *Klebsiella pneumoniae* in 57.75% and 22.54% of BGN; a codominance of Staphylococcus aureus and coagulase-negative Staphylococcus in 27.59% of GC (+) each [11]. On the other hand, our figures are lower than those of Saadoun in Morocco, which had found *E. coli* with a frequency of 69% followed by *Klebsiella spp* (18%) [7]. Similarly in Paris, Chervet in his study on urinary tract infections in the city, reported that most of the urine analyzed was therefore positive for *Eschericha coli* (69.4% in the general population, 74.0% in women and 50.1% in men) [12].

Analysis of the susceptibility test revealed that the majority of *E. coli* strains Coli had a stronger resistance in more than 70% to penicillins (ampicillin), fluoroquinolones (Ofloxacin, ciprofloxacin) and amoxi cillin-clavulanic acid. This rate is significantly higher than that of Takilt et al in Algeria in 2014, reported resistance to *E. coli.* in 13.19% of the Penicillin family, *Klebsiella pneumoniae* was resistant to amoxi-clavulanic acid, amoxicillin, and Ofloxacin. On the other hand, in his study Staphylococcus aureus was practically sensitive to all antibiotics tested, except for Ofloxacin. [10], Saadoun in Morocco noted resistance of *E. coli* to amoxicillin in 64%, although this molecule is not currently recommended for probabilistic treatment of community urinary tract infections [16], 44% to amoxi cillin-clavulanic acid, 36% to ciprofloxacin [7].

In our study about 50% of the strains of *Klebsiella pneumoniae* were resistant to the different classes of antibiotics tested (C3G, Fluoroquinolone, aminoglycosides). This rate is significantly lower than that of Saadoun, which had found strains of *Klebsiella pneumoniae* resistant to third generation cephalosporins (C3G) 22%, aminoglycosides 27% and Ciprofloxacin 42.7% [7]. The increase in resistance of these antibiotics in our study could be explained by inappropriate consumption of these molecules, because more than 60% of our patients had a notion of antibiotic therapy before.

In 2011 in France, the AFORCOPI-Bio study [13] studying the susceptibility of *Escherichia coli* to quinolones and 3rd generation cephalosporins in community-acquired urinary tract infections found a susceptibility to fosfomycin and nitrofurantoin greater than 98%, a resistance to cephalosporins less than 5% and a susceptibility to ciprofloxacin less than 90% but this varied according to age and sex. It ranged from about 85% in women over 65 to 95% in women aged 15 to 65 and about 82% in men.

Imopenem and Amikacin were the most active molecules on BGN especially *E. coli* and *Klebsiella pneumoniae* with a low resistance rate (less than 20%). These molecules are less used in therapeutics by their cost, their limited accessibility and the rational use of these molecules is mandatory in order to avoid the emergence of carbapenemase-producing *E. coli* strains. Multidrug-resistant bacteria are a major public health problem, they accounted for more than half of the germs isolated in our series or 51%. They were mainly dominated by enterobacteriaceae (*E. coli* and Klebsiella pneumoniae) producing ESBL respectively *Escherichia coli* with a frequency of 73.1% or 38 strains out of 54 isolated strains followed by *Klebsiella pneumoniae* or 15.4%.

In France Chervet reported a prevalence of ESBL-secreting bacteria at 4.2% among Enterobacteriaceae, 5.1% among *Escherichia coli* and 3% among *Klebsiella sp* [7], Our figures are higher than in the literature with a prevalence of ESBL-secreting *E. coli* at 1.7% between 2003 and 2006 in the Aresc study [14], to 1.2% in 2007-2008 in the Ecosens II study [15] and to 3% in 2011 in the AFORCOPI-Bio study [16] which confirms that the prevalence of ESBL-secreting *E. coli* is increasing in community-acquired urinary tract infections.

ESBL-producing Enterobacteriaceae are responsible for most nosocomial infections, as approximately all of our patients had undergone bladder catheterization and PVC; In addition, we did not find a statistically significant relationship between the wearing of a bladder catheter, the peripheral venous catheter and the occurrence of resistance. However, several other factors were associated with this resistance with a statistically significant relationship $p<0.05$. These include HIV infection which was present in 40%, the notion of antibiotic intake prior to hospitalization in 79% of cases but also the duration of hospitalization.

Conclusion

Multi-bacterial resistance appears to be expanding in our hospital. A framework for consultation between practitioners and in collaboration with microbiologists would better guide the prescriptions of anti-infectives.

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