# **Research Article**

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# The use of antibiotics in the university hospitals of Conakry: evaluation of the consumption and the analysis of determinants

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# **ABSTRACT**

**Background:** The main objectives of this study were to evaluate the use of antibiotics; assess the knowledge and perception of prescribers regarding the use of antibiotics; to describe the policy on the use of antibiotics and to identify factors associated with high antibiotic consumption at the University Hospital of Conakry.

**Methods:** This study has two components: a retrospective study covering three months' consumption of antibiotics (From January 2013 to March 2013), and a cross-sectional study on both the knowledge and perception of prescribers concerning the use of antibiotics and the policies on their proper use.

**Results:** Of a total of 1,199 cases examined at the University Hospital of Conakry, 953 patients received at least one antibiotic about 79.5% of the total cases. The total amount consumed was 55.3 DDD / 100 BD. The class of the Extended-spectrum penicillin's was widely the most used at 22.9 DDD / 100 BD. The median knowledge score of prescribers; valued at a total of 8, was equal to 5. The Composite Index for proper use of Antibiotic (CIATB) was 2.25 / 20. Determinants or factors associated with the large use of antibiotics were the hospital site, the ward and the average length of stay.

**Conclusion:** Based on the results of our study, it appears that lot antibiotics are largely consumed at the University Hospital of Conakry; and that consumption are influenced by the hospital site, the ward and the length of stay. This study reveals also the absence of any policy of the rational use of antibiotics. Therefore, the study illustrates the need for the implementation of an antimicrobial stewardship action.

Keywords: Antibiotics, Consumption, Determinants, Conakry, Penicillin's, Hospital

## INTRODUCTION

The inappropriate use of drugs is a major concern of public health programs. Globally, over 50% of all medicines are prescribed, distributed or sold inappropriately and more than 50% of countries do not implement the basic policies to promote the rational use of medicines. In developing countries, less than 40% of

patients in the public sector and less than 30% in the private sector are treated according to clinical guidelines.<sup>2</sup>

Among the current problems related to irrational drug use appears the overuse of antibiotics.<sup>2</sup> Indeed, antibiotics are among the drugs most frequently prescribed to the hospitalized patients. Studies indicate that nearly a third of all of the hospitalized patients receive antimicrobial

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therapy.<sup>3,4</sup> Moreover, antimicrobial agents are among the most costly drug expenditure categories in hospitals, which account for about 20-50% of total drug spending.<sup>5</sup>

Furthermore, the amount of antibiotics used in hospitals and in the community is in correlation with the occurrence of antimicrobial resistance.<sup>6,7,8</sup> The consequence of this increase in the antibiotic resistance in the practice of the hospital is the increase of the morbidity rate, the mortality rate and the cost of the hospitalization.<sup>9</sup>

If the antibiotics have been a revolution in the treatment of infections and the improvement of public health in the twentieth century, the gains from the point of view of reducing the morbidity and the mortality; however, may be lost during the twenty-first century with the emergence of multidrug-resistant bacteria. This is a threat that goes beyond the hospital settings, but particularly affects hospitals. <sup>10</sup> The need to improve the prescription of antibiotics in hospitals worldwide is urgent. But, to achieve the improvements in the rational use of antibiotics, we must first understand the causes; for example, the determinants of appropriate and inappropriate use. <sup>11</sup>

However, before studying the determinants, it is necessary to measure the consumption of antibiotics in an objective way. For this purpose; the analyze of drug consumption by defined daily dose (DDD), developed and updated at regular intervals by the WHO, can be used and this process can provide an opportunity to make a fair comparison between hospitals and countries. <sup>12,13</sup>

Measuring the consumption, according to the WHO standard in teaching hospitals has been the subject of several publications in developed countries. <sup>2,12,14</sup> Despite the frequency of their use, the subject of antibiotics has not been much addressed in African hospitals. The few published studies on antibiotics are often limited to wards or knowledge, attitudes and practices of physicians. <sup>15,16</sup> But to date, very few have focused on the assessment of consumption of antibiotics in university hospitals and the factors associated with that consumption.

The objectives of this study were to evaluate the use of antibiotics, assess the knowledge and perception of antibiotic prescribers, describe the policy on the use of antibiotics and identify the factors associated with a high consumption of antibiotics at the University Hospital of Conakry.

## **METHODS**

Our study was conducted in the University hospital of Conakry, located in the Republic of Guinea. It consists of two tertiary level hospitals, the National Hospital of IGNACE DEEN and National Hospital of DONKA, with a total capacity of 981 beds (466 beds and 515 beds respectively). The following hospitalization wards were

particularly studied: medicine, surgery, pediatrics and maternity. This study has two components: a retrospective study of antibiotics consumption and a cross-sectional study of the knowledge and perception of antibiotic prescribers, and the policy on the use of antibiotics.

For the retrospective study, we analyzed the antibiotics consumption of all patients admitted from January 2013 to March 2013 to the wards of Medicine, Surgery, Pediatrics and Maternity. The unit of measure was DDD /100 BD. Antibiotics included were the systemic ones. The consumption of Imidazole per OS (classified P01) and Rifampicin were also noted. Anti-tuberculosis drugs, antiviral and antiparasitic drugs were excluded. Antibiotics used to target digestive decontamination were also excluded.

The cross-sectional study was focused on the knowledge and perception of antibiotics prescribers firstly, and on the other hand, the policies on the proper use of antibiotics. The sample consisted of all prescribers (medical internists, general practitioners, specialists.) of the above mentioned services; but also, two hospital pharmacy directors regarding the political aspect in the use of the antibiotics. The knowledge was assessed by an adapted questionnaire with a total of eight questions, divided into three case presentations and five questions on the properties of antibiotics. The policy was assessed by the Composite Index for proper use of Antibiotics (CIATB) which consists of three chapters: Organization (O: 4 points), Resources (R: 8) and actions (A: 8 points). The policy was assessed by the consists of three chapters: Organization (O: 4 points), Resources (R: 8) and actions (A: 8 points).

#### Data registration and statistical analysis

Data were entered and analyzed using Excel and STATISTICA Version 10. We made descriptive analysis and inferential statistics. The means of two populations were compared using a T test for independent samples when the distribution is normal or the Mann-Whitney test when it is not. For the comparison of several populations, we used one-way analysis of variance or the Kruskal-Wallis test. Normality was verified using the W test of SHAPIRO-WILK. As for proportions, they were compared using a Chi-square test. In addition, multiple regression analysis was performed to identify the factors associated with the antibiotics consumption in patients. For all analyses, the results were considered significant with  $\alpha = 5\%$  (p <0.05).

# **RESULTS**

## Consumption description

1199 patients were admitted during the studied period (January 2013 to March 2013). 953 patients received at least one antibiotic with 79.5% utilization rate. This rate ranged from 77.6% to DONKA national hospital to 81.8% in IGNACE DEEN National Hospital.

Total consumption rose to 55.3 DDD / 100 BD. This suggests that 55.3% of hospitalized patients received a daily antibiotic. The consumption varied between the two national hospitals, 61.6 DDD / 100 BD at IGNACE

DEEN and 49.7 DDD / 100 BD at DONKA with significant difference (p <0.001). Consumption was larger in maternity than in surgery wards (Table 1).

Table 1: Total consumption of antibiotic at the Conakry university hospital.

Wards	University Hospital		Ignace Deen Hospital		Donka Hospital	
	DDD	DDD/100BD	DDD	DDD/100BD	DDD	DDD/100BD
Medicine	1151.3	36.1	527.2	42.1	624.2	32.2
Maternity	1812	79.2	1089.7	78.4	722.3	80.3
Pediatrics	746	45.9	251.8	40.0	494.2	49.7
Surgery	1262.8	66.8	712.8	77.7	550.0	56.5
Total	4972.1	55.3	2581.5	61.6	2390.7	49.7

p<0.001

Table 2: Consumption by class of antibiotic at the university hospital in Conakry.

ATC class	Consumption in DDD/100 BD			
	Conakry university hospital	Ignace deen Hospital	Donka Hospital	
J01A - Tetracyclines	1.1	1.9	0.3	
J01C - Beta-lactam antibiotics, penicillins				
Which j01ca - penicillins with extended spectrum	22.9	16.2	28.8	
Which j01ce - penicillin sensitive to beta-lactams	0.3	0.1	0.5	
Which j01cf - penicillin resistant to beta-lactams	0.1	0.0	0.1	
Which j01cr - association of penicillin	0.9	0.7	1.1	
J01D - Other beta-lactam				
Which J01DB - 1 <sup>st</sup> Generation Cephalosporins	0.8	0.4	1.2	
Which j01dd - 3 <sup>rd</sup> Generation Cephalosporins	14.7	21.8	8.4	
J01E - Sulfonamides and trimethoprim	3.9	2.1	5.4	
J01F -Macrolides	1.9	3.5	0.5	
J01G - Aminosides	1.9	3.8	0.2	
J01M - Quinolones	2.6	3.7	1.7	
J01R + j01X - Associations and other antibacterial	3.1	5.3	1.2	
Other classes	1.1	2.1	0.2	
Total	55.3	61.6	49.7	

The consumption is dominated by the class of extended Spectrum penicillin's (22.9 DDD / 100 BD), followed by the 3<sup>rd</sup> generation cephalosporin's (14.7 DDD / 100 BD). There is a significant difference (p <0.001) between the two national hospitals (Table 2). The median duration of treatment was 3 days; for example, 2 days in Maternity and 5 days in the other wards. 86.1% of all doses were given parenterally (data not shown).

# Knowledge and doctor's perception

Of a total of 189 prescribers who received the questionnaire, 164 responded with a response rate of 86.8%. Of the 164 respondents, 89 (54.3%) were in the Ignace Deen hospital and 75 (45.7%) at Donka hospital.

There was no significant difference between the two hospitals in the characteristics of prescribers.

The median knowledge score of prescribers, established with a total of 8, was equal to 5, with a P25 of 4 and P75 of 6, but no differences between the two national hospitals (p = 0.865) (data not shown).

Prescribers surveyed think in most cases, that self-medication (91.5%), and the fact that the patient did not finish the treatment (79.3%), are the main causes for the development of antibiotic resistance. Only 9.76% cite the large prescription and the high consumption of antibiotics in hospitals (Figure 1).

Table 3: Composite index for proper use of antibiotics (CIATB).

Categories	Measures	Maximum score	Ignace deen hospital	Donka hospital
	CIATB 1			
Organization	Presence of an antibiotic committee	4	0	0
	CIATB 2			
Resources	Presence of a referent in antibiotic	4	0	0
	CIATB 5			
	Computer connection between prescribers services, laboratory	1	NA*	NA*
	and pharmacy Computerized prescription drugs	2	NA*	NA*
	CIATB 6			
	Training of new prescribers	1	0	0
Actions	CIATB 3 Protocol of antibiotics	2	2	2
	CIATB 4			
	List of available antibiotics List of antibiotic dispensing controlled Controlled with a limited duration of treatment	0.25 0.5 0.25	0.25 0 0	0.25 0 0
	CIATB 7			
	Evaluation of antibiotic consumption	2.5	0	0
	CIATB 8			
	Surveillance of antibiotic consumption	2.5	0	0
	Total	20	2.25	2.25
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<sup>\*</sup>Not applicable

## Evaluation of policies

The Antibiotic policies evaluated using the CIATB show that the two national hospitals are identical (2.25/20). This score corresponds to the lower category (performance class E) if they were compared to French hospitals (Table 3).

## Determinants analysis

The determinants of antibiotic use were analyzed in two ways. First, we use a regression model analysis of covariance; we analyzed the determinants of consumption in the patient (number of DDD / patient). This reveals that the amount of antibiotics received by a patient is significantly associated with the duration of hospitalization, the site of hospital and the type of service. The age and the gender of the patient when adjusted for the type of ward were no significant (Table 4). We also tested in univariate analysis if consumption of DDD / 100 BD in service was associated to others determinants. We found a non-significant negative

correlation (r = -0.64) with the knowledge score (p = 0.47) and a positive (r = 0.85) and significant correlation (p = 0.007) with patient demand (data not shown).

Table 4: Determinants associated with the consumption of antibiotics in patients.

Variables	Regression coefficient	p value
Ord.Orig.	3.311	< 0.001
Age	0.007	0.52
Sex	0.576	0.12
Number of hospitalization days	0.285	< 0.001
Hospital Donka	-0.593	< 0.001
Ward		
Surgery	2.295	< 0.001
Medicine	0.436	0.20
Pediatrics	-1.519	< 0.001
Hospital Donka*Ward Surgery	-1.213	< 0.001
Hospital Donka*Ward Medicine	0.309	0.25
Hospital Donka*Ward Pediatrics	0.781	0.004

Summary of regression: R = 0.59; p<0.001; R<sup>2</sup> Adjusted = 0.34

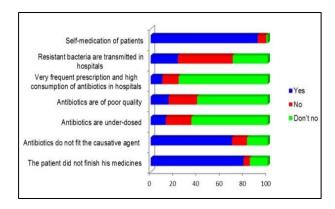


Figure 1: Doctor's perception on the causes of bacterial resistance.

#### **DISCUSSION**

## Consumption description

Our study on the use of antibiotics showed that 79.5% of hospitalized patients receive at least one antibiotic in the Conakry University Hospital. This rate seems relatively high when compared to European countries like Norway (16.6%), <sup>18</sup> Turkey (30.6%), <sup>19</sup> and even Italy (45.5%), <sup>20</sup> despite this country has one of the highest rates in Europe. However, a similar rate in our study has been reported in China (77.8%), <sup>21</sup> and a greater rate in Nigeria (96.7%). <sup>22</sup> This difference with European countries could be partly due to the difference in the epidemiology of diseases and the reasons for hospitalization; but also, to the implementation of policies for the rational use of antibiotics.

The total consumption of antibiotics was 55.3 DDD/100 BD. Moreover, this level of consumption of antibiotics in our study is higher than that of European countries. <sup>23</sup> It is also higher than the results reported in Indonesia. <sup>24</sup> The paucity of data in the African region on the evaluation of antibiotic consumption by the standards of the WHO (DDD/100 BD) does not allow a comparison with the data from African countries.

Extended-spectrum penicillin's are the most frequently used antibiotics (41%) at the University Hospital of Conakry. The third generation of cephalosporin's is the second most consumed large classes (27%). This rate rises to 43% in the Maternity ward of Ignace Deen, when the use of the 3<sup>rd</sup> generation of cephalosporin's represents only 4% of consumption in the maternity of Donka. This difference of practice needs further analysis.

The median duration of antibiotic treatment in the University Hospital of Conakry was 3 days, with an extreme at 20 days. A meta-analysis of five randomized trials totaling 2800 patients showed that the treatment for below 7 days for mild to moderate pneumonia was as effective as treatment for above 7 days with the same antibiotic at the same dosage.<sup>25</sup> Optimizing the duration of the antibiotic therapy is an important measure to

reduce the side effects, prevent the resistance and reduce the processing costs. The knowledge of the optimal duration of the therapy for common infections, responsible for the vast majority of antibiotic consumption, would be particularly useful.<sup>26</sup>

Parenteral route was chosen in 86.1% of prescriptions with significantly more intravenous antibiotics used in the Donka Hospital (88.3%) than in the Ignace Deen Hospital (84.6%). This rate, despite being high, is superimposed on a reported rate (83.7%) in France. Although parenteral use often depends on the clinical condition of the patient, we must remember that using injections when oral formulations are as effective is an irrational use of drugs because the cost of injections is always higher than the oral therapy. Moreover; it increases the risk of blood-borne diseases such as hepatitis and HIV / AIDS. 28

Finally, it should be noted that our study also revealed that no susceptibility testing was performed for the 953 patients included. Therefore, we can conclude that the antibiotics use in the Conakry University Hospital is essentially empirical and there are probably few data on local epidemiology to help physicians in the clinical decisions.

The analysis by a regression model shows that the hospital site (greater amount if the patient is hospitalized in Ignace Deen), service (more antibiotics in surgery and fewer antibiotics in Paediatrics), and length of stay was associated with higher antibiotic consumption (Table 4). Age and sex of the patients were not determinant in the use of antibiotics. These results are consistent with various literature data. Indeed, a study in 77 French hospitals reported that the duration of stay in the medical and surgical services was one of the predictors of change in antibiotic consumption.3 In a thesis in Indonesia; Hadi has reported that, compared to the patients treated in the department of internal medicine, the probability of having a prescription of an antibiotic in the department of surgery was 4.9, 4.5 for pediatrics and gynecology and 3.4 for Obstetrics.<sup>24</sup>

#### Knowledge and doctor's perception

The median score of knowledge about the antibiotics is similar to the scores reported in the Democratic Republic of Congo. <sup>16</sup> It is often assumed that the differences in the practices of the prescription of health care providers are inextricably linked to a variable level of training and knowledge. <sup>29,30</sup> However, there is a little evidence to support this hypothesis. <sup>31</sup> It is interesting to note that our study shows the influence of the knowledge on prescribing practice. The analysis of the determinants of consumption by wards showed a negative, but not significant, correlation (r = -0.64), between the knowledge score and the consumption expressed in DDD/100 BD (p = 0.47).

In our study, the perception of the causes of resistance shows that prescribers are more likely to make patients responsible for the development of drug resistance (self-medication, incomplete cure). Few believe that the prescription and the high consumption of antibiotics in hospital alone are one of the most important causes of drug resistance. This could limit the impact of measures to reduce the emergence of resistance; because according to the social cognitive theory, the behavior of an individual is conditioned in part by the perception that the individual has about the consequences of his actions.<sup>32</sup>

## Evaluation of policies

The CIATB reflects the level of commitment to the health facility, in an optimization of the effectiveness of the antibiotic treatment strategy. The CIATB obtained at Conakry shows a lack of any measure aimed at the rational use of antibiotics. Some studies report that political actions (antibiotic's policies) in hospitals could influence the use of antibiotics in a specific organization. In their survey of 977 French hospitals, Amadeo et al. found a positive correlation between antibiotic consumption expressed in defined daily doses (DDD) and CIATB. The commitment of the commitmen

However, our study did not allow us to compare both hospital antibiotic policies on consumption since CIATB score was the same in both hospitals. However, the analysis of data collected shows that these two hospitals are different in terms of consumption of antibiotics. Other factors could explain these differences in practices, such as case-mix of hospitals or quality of services.

#### **CONCLUSION**

A potential limitation of the study can be found in the limited accuracy of measuring the amount of antibiotics given by the retrospective review of medical records, the absence of coupling consumption data with case-mix and the self-selection bias in the cross sectional component. However, few data on antibiotics consumption in developing countries are available. The results of this study could be useful for managers, physicians, pharmacists of both hospitals as executives of the Ministry of Health of Republic of Guinea; but also, by extrapolation. for other surrounding Measuring, or defining indicators, is the first step of an intervention plan. This study, by using the standardized method proposed by the WHO for measuring the consumption of antibiotics, allows the comparison with other countries in the world.

In the end, based on the results of our study, it appears that a lot of antibiotics are consumed in the Conakry University Hospital and that consumption is influenced by the hospital site, the medical discipline and the length of stay. We also observed the absence of a policy of the rational use of antibiotics. That illustrates the urgent need

for implementation of an Antimicrobial Stewardship Action.

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