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Hospital-Based Antibiotic Therapy in Benin: A Point Prevalence Survey at the Departmental and Teaching Hospital of Borgou-Alibori in 2022

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Abstract: Antimicrobial resistance is a public health problem. The main factor favoring the development of antibiotic resistance is the abusive or inappropriate use of antibiotics. This study is the first to take all services into account and aims to describe antibiotic therapy practices in the Departmental and Teaching Hospital of Borgou-Alibori (DTH-BA). Patients and methods: This was a cross-sectional, descriptive survey conducted at DTH-BA from January 11 to 18, 2022. An exhaustive recruitment of all hospitalized patients was carried out through a single and punctual passage at 16:00 in each hospital department. Data were collected using the WHO's standard questionnaire for point prevalence surveys of antibiotic use, from PPS V6. The web application (GLASS-HAMUPPS) was used for data entry, validation and processing. Analysis was performed using EPI-INFO software. The survey protocol has been approved by the national health research ethics committee. Results: A total of 145 patients were included from 9 hospital wards. The sex ratio was 0.69. The mean age of hospitalized children was 3.13±4.17 years and that of adults was 35.76±15.54 years. The overall frequency of antibiotic treatment across all departments was 70.34%. Pediatrics (90.90%) and intensive care (87.50%) were in the lead. Empirical antibiotic therapy was used in 98.41% of cases. Amoxicillin/clavulanic acid was the most prescribed antibiotic (17.99%), followed by metronidazole (15.87%), ampicillin (15.35%) and ceftriaxone (14.28%). Community-acquired infections accounted for 61.91% of cases. The frequency of medical antibiotic prophylaxis was 22.22% and surgical prophylaxis was 11.64%. Conclusion: Antibiotic consumption was high at DTH-BA and involved almost exclusively probabilistic antibiotic therapy. A program of proper use and monitoring of antibiotic prescriptions, coupled with improved access to microbiological tests, is needed to improve practices.

Keywords: Antibiotic, Point Prevalence, Hospital, Benin

Introduction

Antibiotic use plays a crucial role in reducing mortality from bacterial infections (Ndihokubwayo *et al*., 2013). However, Antibiotic Resistance (AMR) is increasingly complicating the management of certain hospital-acquired infections and has become a major concern for practitioners worldwide 9 (Horumpende *et al*., 2018; Laxminarayan *et al*., 2016) but particularly in sub-Saharan Africa, where hygiene measures are defective,

increasing the number of cases of infectious pathologies in a context where antibiotics of last resort are not always available in pharmacies (Pauwels *et al*., 2021; Ouedraogo *et al*., 2017; Opatowski *et al*., 2019). Bacteria are said to be resistant to an antibiotic when they are capable of continuing to adapt and proliferate in the presence of the antibiotic in question (Mondiale de la Santé, 2016). Antibiotic resistance is not a new phenomenon, but it is its scale and the growing number of resistance mechanisms observed in recent years that pose a threat to the healthcare system (Leeson and Hsueh, 2015; Da *et al*., 2023). Indeed, it has become one of the 10 leading causes of death worldwide, with the highest number of cases attributed to the West African region (Laxminarayan *et al*., 2016; Murray *et al*., 2022; Vounba *et al*., 2022).

Antimicrobial stewardship is a program that promotes the rational use of antibiotics, improves patient care, reduces antibiotic resistance and lowers the rate of infectious diseases caused by multi-resistant bacteria (Bitterman *et al*., 2016). The lack of quality data, especially in our African countries, is an obstacle to the success of this program. In a bid to combat resistance, in May 2015, the World Health Organization (WHO) proposed a National Action Plan (NAP) for countries to combat AMR with five key objectives (Elton *et al*., 2020; Tadesse *et al*., 2017). There is a disparity in the implementation of these plans due to the low level of commitment observed and also to the lack of funding in southern countries (Yehouenou *et al*., 2023). In Benin, for example, the NAP has been drawn up and validated by the authorities since August 2020, but the real challenge remains the implementation of quality bacteriology laboratories to ensure AMR surveillance.

Antibiotic resistance is a reality in Benin (Dohou *et al*., 2022; Yehouenou *et al*., 2020). It is fueled by the absence of a national guide to the proper use of antibiotics, inadequate initial and in-service training for healthcare workers on the rules and procedures for prescribing antibiotics and a lack of control over the antibiotic distribution circuit. Antibiotics are still sold on the informal market, encouraging self-medication. These factors have a definite influence on the consumption of antibiotics in Benin's hospitals. In fact, there is a direct correlation between the level of antibiotic use and the frequency of resistance (Thabet *et al*., 2021). The present study is the first to take into account all the hospital's departments and to use a validated and appropriate methodology to assess the practice of antibiotic therapy in this context. The objectives of this study are to describe antibiotic consumption and to assess the quality of antibiotic prescriptions at the Departmental and Teaching Hospital of Borgou-Alibori (DTH-BA), in order to optimize the proper use of antibiotics in Benin's healthcare environment.

Materials and Methods

Study Framework

The study took place in the Republic of Benin, in the department of Borgou, one of the country's twelve departments. Borgou borders the Federal Republic of Nigeria. Benin's health system is organized on three levels: A central level with the presence of major reference hospitals and research institutes, an intermediate level and a peripheral level which is the first point of contact with the population. DTH-BA is the second level of the health pyramid and at the same time the referral hospital for Nord-Benin. The hospital has around 300 beds in 14 departments. It provides training for medical students, orderlies, nurses, interns and doctors undergoing specialization.

Type and Period of Study

This was a descriptive cross-sectional study. Data collection took place during the week of January 11-18, 2022.

Study Population

The study covered patients of all genders hospitalized in the DTH-BA wards during the study period.

Inclusion Criteria

This study included:

- All patients present at 4:00 p.m. on the day of the survey in each department concerned and still hospitalized at the time of the survey
- All patients who have given informed consent (for patients who are unable to give informed consent themselves, such as children, patients in coma, or critically ill patients, informed consent is taken from a parent)

Non-Inclusion Criteria

Were not included in this study, patients:

- Kept in the emergency department awaiting transfer to a hospital ward
- Already discharged and seen in theatres at the time of the survey
- Whose medical record could not be found or whose medical record is unusable (missing data)
- Absent from bed during recruitment

Sampling Technique

Exhaustive sampling was used to systematically recruit all patients hospitalized at the time of the survey in each hospital department.

Course of the Study

The survey was conducted by four (04) interns, five (05) nurses, two (02) midwives and an epidemiological technician under the supervision of an assistant professor of internal medicine and an associate professor of infectious diseases. The interviewers were selected through a restricted consultation. The main selection criterion was previous experience in collecting data from medical records. During the preparatory phase, the interviewers were trained on the collection tools. Then, a review of the number of hospital beds and their occupancy was made throughout the hospital, which allowed for good planning of the survey. A timetable was drawn up, which enabled us to visit the various hospital departments, notably internal medicine, cardiology, neurology, psychiatry, intensive care, ENT, surgery, pediatrics and gynecology-obstetrics.

A pre-test was carried out to ensure the interviewees' understanding of the collection tool. Each interview reviewed a medical file and completed the collection tool.

The actual data collection phase began each time with an interview with each patient to obtain informed consent and verify the presence or absence of invasive medical devices. The medical records were then examined to ascertain the presence or absence of underlying infectious disease, whether or not surgery had been performed during hospitalization, whether the patient had received antibiotic therapy, the details of this therapy (name, international common denomination, dosage, dose and route of administration), the germ identified on any microbiological samples and the results of the antibiotic susceptibility test.

Data Processing and Analysis

Data were entered on the web platform for the WHO point prevalence survey on antibiotic use in hospitals platform (HAMUPPS) (WHO, 2018). This platform was used to enter, clean and validate the data which was then exported to an Excel database and analyzed using EPI-INFO 7.2. software.

Ethical Considerations

The survey protocol has been approved by the national health research ethics committee (CNERS) under No. 142 /MS/DC/SGM/CNERS/SA of December 28, 2021.

Results

Description of the Study Population

Socio-Demographic Characteristics

Included were 148 patients hospitalized in various departments, of whom 03 were excluded (file not found). Analyses were performed on a total of 145 files.

The mean age of hospitalized children was 3.13±4.17 years, while that of hospitalized adults was 35.76±15.54 years. The median age was 23 years, with the largest group aged between 16 and 45.

The sex ratio was 0.69, with 86 (59%) female subjects and 59 (41%) male subjects.

Breakdown of Inpatients by Department

During the week of collection, pediatrics, gynecology and general surgery had the highest number of hospitalized patients, with respectively (n = 44; 30.34%) (n = 34; 23.45%) and (n = 29; 29.20%) of the total number of patients (Table 1).

Point Prevalence of Antibiotic Use at DTH-BA

The point prevalence of antibiotic use was 70.34% (102 out of 145 patients were on antibiotics).

By department, the prevalence was 90.91% in pediatrics and 87.50% and 76.47% in intensive care and internal medicine respectively (Table 1).

Among the 102 patients who received antibiotics, the parenteral route was used in most cases (89.22%), followed by the oral route (10.78%). No intramuscular, subcutaneous, or rectal administration was observed during the survey.

Table 1: Characteristics of antibiotic therapy by DTH-BA hospital departments in 2022 (N = 145)

Service	Number of patients included department	Number of on antibiotics (N = 102)	Punctual prevalence of antibiotic therapy	Number of times antibiotic prescribed (N = 189)	Average antibiotic prescribed per patient
Pediatrics	44	40	90.91	86	2.15
Gynecology	34	20	58.80	37	1.85
Surgery	29	17	58.62	28	1.65
Resuscitation	8	7	87.50	11	1.57
Internal medicine	17	13	76.47	20	1.54
Orl	4	2	50.00	3	1.50
Neurology	3	2	66.67	3	1.50
Cardiology	3	1	33.33	1	1.00
Psychiatry	3	0	0.00	0	0.00

Table 2: Frequency and classification of antibiotic therapy at DTH-BA in 2022 (N = 189)

Antibiotic	Number	%	AWaRe classification
Amoxicillin + clavulanic acid	34	17.99	Access (n = 117; 61.91)
Metronidazole	30	15.87	
Ampicillin	29	15.35	
Gentamicin	19	10.05	
Amoxicillin	4	2.12	
Cloxacillin	1	0.53	
Ceftriaxone	18	9.52	Watch (n = 62; 32.80%)
Cefotaxime	18	9.52	
Ciprofloxacin	8	4.23	
Azithromycin	7	3.70	
Vancomycin	4	2.12	
Erythromycin	2	1.06	
Ofloxacin	2	1.06	
Lincomycin	1	0.53	
Ceftazidime	1	0.53	
Imipenem	1	0.53	Reserve
Ceftriaxone + sulbactam	9	4.76	Uncategorized

Table 3: Indications sites and types of infection requiring antibiotic therapy at CHUD BA in 2022

	Number	%
Indications		
Community infection	117	61.91
Medical prophylaxis	42	22.22
Surgical prophylaxis	22	11.64
Unspecified indications	8	4.23
Infected sites or types of infection		
Pneumonia	29	24.79
Sepsis	21	17.95
Neonatal infections	15	12.82
Central nervous system infections	14	11.96
Gastrointestinal infections	13	11.11
Gynecological infections	10	8.55
Osteoarticular infections	6	5.13
Systemic inflammatory response syndrome	4	3.42
Urinary tract infections	3	2.56
Oral Infection	2	1.71

Around 2/3 (65.69%) of patients on antibiotics were receiving more than one antibiotic, with 47 cases (46.08%) of double antibiotic therapy. Overall, during the survey, antibiotics were prescribed 189 times, with an average of 1.85±0.74 per patient.

Beta-lactam antibiotics were the most frequently prescribed family, with a frequency of 60.85%. Among these antibiotics, aminopenicillins accounted for 35.98% of all prescriptions and 59.13% of beta-lactams. Cephalosporins were the second most prescribed class after penicillins, accounting for 24.34% of prescriptions. Table 2 summarizes the families and sub-families of antibiotics prescribed.

Amoxicillin alone or in combination with clavulanic acid (n = 38; 20.11%), metronidazole (n = 30; 15.87%), ampicillin (n=29; 15.35%) and ceftriaxone alone or in combination with sulbactam (n = 27; 14.29%) make up the top 4 antibiotics used on the wards (Table 2).

Microbiological Characteristics

Of the 102 patients receiving antibiotics, 92 (90.20%) had not undergone bacteriological tests during hospitalization. One hundred and eighty-six (98.41%) prescriptions were made on a probabilistic basis, with no evidence of bacteriological analysis. Antibiotic therapy was documented in 3 cases (1.59%).

Characteristics of Indications for Antibiotic Therapy

Community infection was the most frequent indication (117 cases; 61.91%), followed by medical prophylaxis (42 cases; 22.22%) and surgical prophylaxis (22 cases; 11.64%).

Pneumonia (n = 29; 24.79) tops the list of indications for antibiotic therapy, followed by sepsis (n = 21; 17.95) (Table 3).

Features of Antibiotic Prophylaxis

Ampicillin (28.57%) and amoxicillin alone or in combination with clavulanic acid (26.20%) were the two most prescribed antibiotics for medical prophylaxis, while amoxicillin (40.90%) and metronidazole (22.72%) were the most prescribed for surgical prophylaxis (Table 4).

Distribution of Antibiotics Prescribed According to Compliance with Therapeutic Guidelines

Antibiotic prescribing on the wards was not based on any formal local or national guidelines or protocols in 86.24% of cases. In 13.76% of cases, prescribing was based on a local protocol. Such protocols existed in the surgery and gynecology-obstetrics departments.

Table 4: Antibiotics used in medical and surgical prophylaxis at DTH-BA in 2022

Antibiotic prophylaxis	Number	%
Antibiotics used in medical prophylaxis		
Ampicillin	12	28.57
Amoxicillin + clavulanic acid	7	16.67
Amoxicillin	4	9.53
Metronidazole	9	21.43
Cefotaxime	6	14.28
Gentamicin	3	7.14
Azithromycin	1	2.38
Antibiotics used in surgical prophylaxis		
Amoxicillin + Clavulanic acid	8	36.35
Amoxicillin	1	4.55
Metronidazole	5	22.72
Ampicillin	3	13.63
Cefotaxine	1	4.55
Ceftriaxone + sulbactam	1	4.55
Ciprofloxacin	1	4.55
Imipenem	1	4.55
Lincomycin	1	4.55

Discussion

This study was carried out with the general aim of assessing the punctual prevalence of antibiotic therapy at DTH-BA. The aim was to calculate the prevalence of empirical antibiotic therapy in hospital wards.

The point prevalence of antibiotic therapy was 70.34%. In a survey carried out in Benin in 2012 in 39 hospitals on a total of 3130 patients, the point prevalence of antibiotic therapy was 64.6% (Ahoyo *et al*., 2014). Ten years later, the figures seem stable, even if this time concerns only one hospital. The current prevalence is close to that observed in three hospitals in Nigeria (69.7%) (Abubakar, 2020). Similarly, in Botswana and Kenya, the prevalences were 70.6-67.7% respectively (Anand Paramadhas *et al*., 2019; Okoth *et al*., 2018). The authors of these studies estimated that the high consumption of antibiotics is the consequence of the high prevalence of tuberculosis and HIV infection in their country (Anand Paramadhas *et al*., 2019; Okoth *et al*., 2018). Immunosuppression increases the frequency of infections and consequently, that of antibiotic consumption. In contrast, the prevalence in other parts of the world was lower, for example in Eastern Europe and Asia, where it was 11.6-42.0% respectively (Versporten *et al*., 2018). Ultimately, antibiotic consumption in hospitals varies from one continent to another, from one country to another and from one department to another. Generally speaking, the biggest prescribers of antibiotics are African hospitals, with prevalence ranging from 27.8-74.7% (Afriyie *et al*., 2020). In Ghana, the survey carried out in 2019 in two hospitals, one being more general with gynecology and general surgery services showed a prevalence of 82% compared with the hospital with the fewest beds available which was 65% (Afriyie *et al*., 2020). For antibiotic prophylaxis, amoxicillin and metronidazole were the most widely prescribed. However, the average duration was 48 h. This was also the case in other countries, such as Congo and Pakistan, where the duration was well in excess of 48 h. In contrast to amoxicillin, ceftriaxone was the mainstay of antibiotic prophylaxis here (Mbuyamba *et al*., 2023; Khan *et al*., 2020). It is important to remind practitioners of the importance of the five criteria of good antibiotic prophylaxis (indication, timing of administration, duration, choice of antibiotics prophylaxis and dosage appropriateness) (Kefale *et al*., 2020). The high level of antibiotic prescribing in the present study is also linked to the all-too-regular practice of empirical antibiotic therapy without any bacteriological evidence.

The prevalence of empirical antibiotic therapy was 98.41%. Very few bacteriological examinations are requested and carried out by practitioners before starting treatment. Although the DTH-BA has a bacteriology unit, only a few tests are carried out at this time. In addition, very few studies on local ecology have been carried out to support prescribers in their choice of treatment in general in the country and specifically in this hospital (Yehouenou *et al*., 2020). This sometimes complicates the management of infectious diseases and could explain the attitude of practitioners who no longer prescribe according to the results of an antibiogram. In fact, the role of the laboratory is crucial to the correct use of antibiotics in the hospital setting. It is the laboratory that not only alerts clinicians to critical resistance mechanisms, but also establishes and ensures inter-laboratory quality control, provides training for the various authors and, moreover, constitutes the first level of "antimicrobial stewardship" (Moirongo *et al*., 2022; Iskandar *et al*., 2021; Malania *et al*., 2021). In the context of resistance monitoring, a survey of laboratories has been carried out and initiatives are underway to equip bacteriology laboratories in major departments to help with data collection. Bacteriological tests of certainty are recommended in order to preserve antibiotics by adjusting antibiotic therapy (de-escalation or escalation).

Community infection accounted for 61.91% of antibiotics prescribed, with pneumonia at the top of the list. The same observation was made in Europe and other countries around the world, with pneumonia representing the leading condition requiring the most antibiotics (Alshammari *et al*., 2023; Eshwara *et al*., 2020). By contrast, in Nigeria in 2019, sepsis (22.8%) was the main indication for antibiotic therapy, followed by pneumonia (17.3%) (Ahoyo *et al*., 2014) Ampicillin and amoxicillin were the most commonly used antibiotics for medical and surgical prophylaxis respectively. In contrast to a study carried out in 2021 in 41 hospitals in Thailand, the top

three antibiotics used were third-generation cephalosporins, first-generation cephalosporins and carbapenems and around 70% of patients had received antibiotic prophylaxis for more than one day (Anugulruengkitt *et al*., 2023). It has to be said that this study was carried out in Thailand, at the height of the COVID-19 epidemic, in referral hospitals for the management of critical cases. Although these hospitals have local antibiotic prescribing guidelines, they are not often applied by their staff. In three hospitals in northern Nigeria, nitroimidazoles were among the most widely used antibiotic classes (28.5%) (Abubakar, 2020) Elsewhere in Tanzania, from 2017-19 the tetracycline class was the most widely used in hospitals (Mbwasi *et al*., 2020). In Cameroon, in a Yaoundé teaching hospital from 2016-21, cephalosporins, imidazole and penicillin made up the top 3 antibiotics most consumed by patients recruited (Demen *et al*., 2023). Indeed, the most commonly used antibiotics vary from country to country. According to the WHO AWaRe classification, amoxicillin alone or combined with clavulanic acid is in the "access" group, while cephalosporins are in the "watch" group. Carbapenems, for their part, are in the "reserve" group, which means that they should be used often after microbiological certainty of infection and in the absence of other therapeutic alternatives, depending on the resistance profile of the germ identified (WHO, 2023). Even if prescriptions are still in the group of antibiotics recommended by the WHO, they do not comply with any local guidelines.

The high frequency of antibiotic prescribing in pediatrics is well known. Many common viral infections in early childhood are mistaken for bacterial infections. The fear of serious, life-threatening bacterial infections in children, coupled with the often unspecific, crude symptomatology of these infections, encourages the over-prescription of antibiotics in pediatric wards.

This study has a number of implications, especially for health authorities. These include building the capacity of hospital practitioners in the rules, methods and principles of curative and preventive antibiotic therapy; developing antibiotic therapy guidelines based on a sound knowledge of local bacterial ecology; setting up a system for monitoring antibiotic prescriptions; and finally, strengthening hospital microbiology laboratories for effective AMR surveillance.

One of the major limitations of this study is that it is a one-off survey in a single hospital and would probably not show all aspects of the problem. It should be carried out on a larger scale, in all hospitals in the country, with, for example, the global PPS, which enables us to see not only antibiotic consumption and healthcare-associated infection rates but also antimicrobial resistance.

Conclusion

This study showed that antibiotic consumption is high at the DTH-BA. This high level of prescribing was of particular interest to pediatrics and the intensive care unit. We do not yet have uncontrolled prescriptions of WHO "Reserve" antibiotics. But in all cases, almost all prescriptions are probabilistic, which suggests the need to reinforce prescribers' skills on the proper use of antibiotics, to raise awareness among prescribers and patients of the need to carry out microbiological examinations, the development of a reference of care and a guide to the proper use of antibiotics and finally, monitoring of the daily consumption of antibiotics in each department by the hospital pharmacy. This context also suggests the implementation of a nationwide antibiotic resistance monitoring system.

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Author’s Contributions

Cossi Angelo Attinsounon: Coordinated the research. Designed the research plan. Coordinated the data collection. Wrote the first draft of the manuscript.

Carine Laurence Yehouenou: Wrote the initial draft of the manuscript.

Aldin Gnaha: Developed the research protocol. Conducted data collection. Contributed to the manuscript written.

Adébayo Alassani: Coordinated data collection. Reviewed the manuscript draft.

Tokpanou Koudjo: Coordinated data collection. Conducted data analysis. Reviewed the manuscript draft.

Angèle Vodounon: Entered data into the platform. Reviewed the manuscript draft.

Al Fattah Onifade: Coordinated data analysis.

Ethics

The research protocol has also been approved by the National Committee for Health Research under number 142/MS/DC/SGM/CNERS/SA of December 28, 2021.

All data from this survey were treated anonymously and with strict confidentiality.

Competing Interests

The authors declare that there are no competing interests.

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Abbreviations

DTH-BA: Departmental and Teaching Hospital of Borgou-Alibori
PPS: Point Prevalence Survey
AMR: Antimicrobial Resistance
PAN: National Action Plan
WHO: World Health Organization