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Original Research Article

Antimicrobial utilization in University of Benin Health Care Centre, Benin City, Edo State, Nigeria

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Abstract

Purpose: The study evaluated the antimicrobial utilizations pattern in the University of Benin Health Centre, with a view to appraising the level of compliance of the Centre to WHO guidelines for rational use of antimicrobial agents.

Methods*:* This was a descriptive cross-sectional prospective study of case files of 200 patients who attended the health centre from 30th May to June 29th 2017. A data collection form was used to collect the following information; name of antibiotics prescribed, indication for use, pattern of combination therapy, justification for antibiotic prescription (laboratory investigation), cost of antibiotic utilization as well as the age and gender of patients. All the case files of patients who were prescribed antibiotics during the study period were screened.

Results*:* A total of 200 prescription encounters were evaluated. Children aged 0-9 years and young adults (20-39 years) were the highest recipients of antibiotics while patients aged 60 years and above received the least number of antibiotics. Malaria fever (31.8%) and respiratory tract infections (28.0%) accounted for the indications that received the highest number of antibiotic prescriptions among the 10 indications for antibiotic utilization. Beta-lactam antibiotics were the most prescribed class of antibiotics both in combination and as a single therapy. The average number of medicines per prescription was 3.71 and percentage of antibiotic prescriptions was 34.2%. Generic prescribing was at 38.0%, while laboratory investigations was 8.5%. However, the percentage cost of encounter was 30.6%.

Conclusions*:* The low rate of percentage cost of antibiotics was rational in comparison with WHO standard range. But the higher than recommended standard for indicators such as average number of medicines per encounter, percentage of antibiotics prescribed and low rate of laboratory investigations implies irrational prescribing. Brand name prescribing was also common and irrational. Thus, there is high rate of irrational prescribing of antibiotics in the study centre and this could further worsen the burden of microbial resistances to these antibiotics.

Keywords: Antimicrobials, compliance, guidelines, utilization

Indexing: Index Copernicus, African Index Medicus

Introduction

Antimicrobial agents are defined as molecule that inhibits or kills microbes by interaction with specific microbial target cells, without any consideration of the source of the particular compound [1]. While some of these agents kill (bactericidal) others inhibit (bacteriostatic) the growth of microorganisms [2]. These agents are potent and highly effective in combating infectious diseases of microbial origin and have thus been used for effective treatment of a wide range of bacterial infections [3]. Indiscriminate and inappropriate use of antibiotics in communities and hospitals have contributed significantly to the increasing public health problem of microbial resistance to these lifesaving agents [4]. The amount of antibiotics consumed in a community has been

linked directly to the amount of antibiotic resistance found there [5]. In most countries, about 80.0% of antibiotics are used in the community and 20.0% in health care facilities. These are either purchased over the counter by consumers or care givers without prescription or prescribed by health care providers within the community [6].

Between 2000 and 2010, the total global antibiotic consumption grew by more than 30.0 %, from approximately 50 billion to 70 billion standard units based on data from 71 countries [7]. The average antibiotic prescription encountered in some developing countries have been documented as follows; Yemen (51.0%), Sudan (30.0-60.0%) and Cambodia (10.0-66.0%) [8-10]. In Osun State of Nigeria, the average antibiotics prescription encountered was recorded as 50.1% [11]. Increased usage of antimicrobials for unjustifiable indications, at suboptimal doses, in the absence of definitive microbiological diagnosis, patient pressure, as well as competitions for patients among medical practitioners are all contributory factors to the development of microbial resistance to these agents [12].

Irrational utilization of antimicrobial agents has become a major global challenge as it has caused a spike in the global burden of resistant pathogens to available antimicrobials, leading to an increase in morbidity and mortality. It is therefore important that continuous surveillance studies on the utilization pattern of antimicrobial agents must be carried out at local, national and global levels in order to avoid returning to the pre-antibiotic era. This study evaluated the antimicrobial utilization in the University of Benin Health Centre, Benin City, with a view to appraise the level of adherence to WHO indicators for antibiotic prescription

Methods

Study design

This was a descriptive cross-sectional prospective study conducted in University of Benin Health Centre; a primary health care facility in Benin City, Nigeria. It is a general practice clinic where about 80% of its cases are outpatients. The population comprised mainly persons on campus. These include; staff of the University and students; at primary, secondary and tertiary levels.

Data collection

Following ethical approval from the University of Benin Institutional Review Board. A total of 500 case files of patients who visited the study centre within the period of 30th May to 29th June 2017 were assessed. Of this, 200 case files were selected. Patients whose prescriptions contained antimicrobial agents were included in the study and those without antimicrobial agents were excluded. Patient information were collected with a data collection form and these included; age, sex, indication for treatment, antibiotics prescribed, additional prescribed drugs, laboratory investigations, brief history of illness, cost, antibiotics dosage regimen and antibiotics duration of therapy.
Rational use of antimicrobial agents at the study centre was evaluated by measuring the indicator variables for rational antibiotic utilization as outlined by WHO and the outcome variables obtained were compared with the WHO 1993 indicator for antimicrobial utilization as standard.

Data analysis

Data was entered into Microsoft Excel 2010 and descriptive statistics done. Results were presented as frequency and percentages.

Results

A total of 200 medical records of patients were evaluated; 136 (67.0%) were for adults while 64 (32.0%) were for children. Majority of the adults were female (83; 41.5%) and majority of the children were male (46; 23.0%) (Table 1).

Table 1: Socio-demographics of patients who received a prescription for antimicrobial agents at the study centre

Variables	Frequency	Percentage
Gender		
Adult male	53	26.5
Adult female	83	41.5
Male children	46	23.0
Female children	18	9.0
Age distribution		
0-9	49	24.5
10-19	19	9.5
20-29	7	3.5
30-39	49	24.5
40-49	38	19.0
50-59	31	15.5
60 and above	7	3.5

Patients within the age range of 30-39 (24.5%) and 0-9 (24.5%) years were the highest recipients of antimicrobial agents while patients aged 60 years and above had the least prescription with antimicrobial agents.

Ten different indications were encountered in the study (Table 2). Malaria and respiratory tract infections were the most prevalent. Accounting for 48.0% and 41.0% respectively. The prevalence of sexually transmitted infection was low (0.7%).

Out of the 200 reviewed prescriptions, 30 (15.0%) patients received antibiotic combination therapy while 170 (85.0%) received single antibiotics (mono-

therapy). Patients who received a combination of antibiotics were mainly given β lactam antibiotics in combination with macrolides 4 (13.3%), and metronidazole 10 (33.3%), others are as shown in Table 3. The penicillins (133; 59.4%) were the most frequently prescribed class of antibiotics, followed by the cephalosporins (24; 10.7%) and fluoroquinolones (22; 99.8%). Of the penicillins; the branded amoxicillin/clavulanic acid (26.3%) combination accounted for the most prescribed antibiotics followed by amoxicillin (25.9%), metronidazole (8.5%) and ampicillin/cloxacillin (7.1%). Table 4.

Only 17 (8.5%) files had a record of laboratory investigations carried out prior to antibiotic prescription. Of this number, only 6.5% of the laboratory results were used as a guide for prescribing antimicrobials.
In the study, a total cost of antibiotics utilized by the patients during the period of study was one hundred and fifty-eight thousand and thirteen naira (₦158,013.00). Amoxicillin/clavulanate accounted for the highest cost of antibiotics (₦89,800) (Table 5).

Table 2: Indications for antimicrobial prescription in patients at study centre

Indications	**Female** Freq. (%)	**Male** Freq. (%)
Malaria	42 (29.4)	48 (34.3)
Respiratory diseases	41 (28.7)	15 (10.5)
Gastrointestinal infections	39 (27.9)	12 (8.6)
Genitourinary infection	12 (8.4)	7 (5.0)
Ear, nose and eye disease	9 (6.3)	9 (6.4)
SSTI	8 (5.6)	6 (4.3)
CVS	5 (3.5)	4 (2.9)
Diabetes mellitus	2 (1.4)	0 (0)
STI	1 (0.7)	0 (0)
Other infections	8 (5.6)	15 (10.7)

CVS; Cardiovascular system disease, SSTI; Skin and soft tissue infection, STI; Sexually transmitted infection. Freq; Frequency

Table 3: Pattern of antimicrobial combination therapy in patients at the study centre

Combined antibiotics therapy	**Number**	**Percentage**
β-lactam + chloramphenicol	2	6.7
β-lactam + tetracycline	1	3.3
β-lactam + metronidazole	10	33.3
β-lactam + aminoglycosides	1	3.3
β-lactam (IV) + β-lactam (OP)	5	16.7
β-lactam + macrolides	4	13.3
Tetracycline + metronidazole	2	6.7
Quinolone + metronidazole	3	10
Quinolone + tetracycline	1	3.3
Macrolide + metronidazole	1	3.3
Total	**30**	**100**

Table 6, compares the prescribing indicators in the study centre to the WHO indices. The prescribing indicators in the study such as; the average number of drugs per prescription (3.71), percentage of antimicrobial per prescription (34.2%), percentage of drugs prescribed in generics (38.0%), percentage cost of encounter (30.6%) and laboratory investigation (8.5%) were all out of range of the WHO recommended values.

Discussion

More females were encountered in the study and consequently received more antibiotics. This disparity may be due to the frequent visits of women to the hospital. It has been reported in other countries that women consult their general practitioner (GP) more often than men [13-17] and consultation rate has been linked to antibiotic prescribing [18]

Gender has been documented as a key determinant of antibiotic prescribing as studies across primary care facilities in nine high-income countries found that women received more antibiotics than men in all age groups except those above 75 years. Women aged between 16 - 54 years received 36.0 - 40.0% more antibiotics than men of the same age [19]. Similarly, across English and Welsh primary care facilities the rate of antibiotic prescribing has been found to be 40.0% higher in female than in male patients [20]. These differences in prescribing are partly due to differences in health-seeking behaviour, with healthy adult women consulting primary care centres approximately 80.0% more than healthy adult men across the 12 conditions included in this study.

A total of 10 indications were recorded of which malaria was the highest for both female and male patients. For every case for which malaria was indicated, an antibiotic agent was administered. This finding represents a higher use of antibiotics in malaria fever than as reported in a similar study carried out in southern Nigeria which reported 14.1% antibiotic use [21]. Respiratory infections were the next most prevalent indication for antibiotics, followed by genitourinary disease. This study showed that few patients above 60 years received antibiotics. This may be due to the age distribution of patients in the study centre as they were mostly children, students and adults below 60 years.

The group of antibiotics mostly utilized or prescribed in this study were the penicillins followed by the cephalosporins and the fluoroquinolones. This observation is in agreement with existing literature which indicated that penicillins and cephalosporins (β-lactams) are the most utilized class of antibiotics [22]. β-lactams have continued to be the mainstay of antimicrobial therapy due to their wide spectrum of activity against gram positive and negative organisms

as well as their high rate of recorded efficacy, safety, tolerance and as well as their cost.

The combination of β-lactams with macrolides was frequently encountered in the study. Macrolides apart from being anti-infective, also have anti-inflammatory and immunomodulatory effects in humans. This immunomodulatory activity of macrolides is related to the lactone ring in their chemical structure, which is seen with the 14-membered ring (erythromycin, clarithromycin, and roxithromycin) as well as the 15-membered ring

Table 4: Classes of antibiotics prescribed at the study centre

Classes of antibiotics	Types	Number	Percentage
Macrolides	Azithromycin	13	5.8
	Erythromycin	2	0.9
	Clarithromycin	2	0.9
Penicillins (β-lactams)	Amoxicillin	58	25.9
	Amoxicillin/Clavulanate	59	26.3
	Ampicillin/Cloxacillin	16	7.1
Cephalosporins (β-lactams)	Ceftriaxone	4	1.8
	Cefixime	6	2.7
	Cefuroxime	14	6.3
Fluoroquinolones	Ciprofloxacin	14	6.3
	Ofloxacin	7	3.1
	Levofloxacin	1	0.4
Tetracyclines	Tetracycline	1	0.4
	Doxycycline	5	2.2
5-nitroimidazole	Metronidazole	19	8.5
Aminoglycosides	Gentamicin	1	0.4
Other antibiotics	Chloramphenicol	2	0.9

Table 5: Cost of prescribed antimicrobials in the study centre

Antibiotics prescribed	Unit	Unit price (₦)	Total number	Total price (₦)	Percentage
Amoxicillin	Cap	15	503	7545	4.7
Amoxicillin	Sus	300	7	2100	1.3
Amoxicillin/Clavulanate	Vial	1000	2	2000	1.3
Amoxicillin/Clavulanate	Tab	150	404	60600	38.5
Amoxicillin/Clavulanate	Sus	1600	17	27200	17.2
Ampicillin/Cloxacillin	Cap	15	233	3495	2.2
Azithromycin	Tab	150	13	1950	1.2
Azithromycin	Sus	1600	5	8000	5.1
Cefixime	Tab	200	6	1200	0.7
Ceftriaxone	Vial	1800	4	7200	4.6
Cefuroxime	Tab	170	34	5780	3.6
Cefuroxime	Sus	1200	7	8400	5.3
Cefuroxime	Vial	750	1	750	0.5
Ciprofloxacin	Tab	65	98	6370	4.0
Clarithromycin	Tab	150	26	3900	2.5
Doxycycline	Cap	10	78	780	0.5
Erythromycin	Cap	30	15	450	0.3
Gentamicin	Gutt	300	1	300	0.2
Chloramphenicol	Gutt	300	2	600	0.4
Levofloxacin	Tab	110	7	770	0.5
Metronidazole	Tab	3	221	663	0.4
Ofloxacin	Sus	200	1	200	0.1
Tetracycline	Tab	80	97	7760	4.9
Total			**1782**	**158013**	**100**

1USD = ₦310

Table 6: Comparison of prescribing indicator at study centre with WHO standard values

Prescribing indicators	Study Centre	WHO value
Average number of drugs per prescription	3.71	1.6 - 1.8
Percentage of antimicrobial per prescription	34.23	20.0 - 26.8
Percentage of drugs prescribed in generic	38.00	100
Percentage cost of encounter	30.55	20 - 40
Laboratory investigation (%)	8.50	100

(azithromycin) macrolides. These antibiotics inhibit the production of many pro-inflammatory cytokines, such as interleukin (IL)-1, IL-6, IL-8 and tumor necrosis factor-alpha (TNF-α). In particular, IL-8 is a potent neutrophil activator and chemo-attractant. The ability of this class of drugs to inhibit cytokines on one hand, while decreasing mucus hyper-secretion in the airway goblet cells, may justify in part the combination of macrolide with β-lactams in the treatment of respiratory tract infections in the study centre [23,25].

Branded amoxicillin/clavulanic acid combination accounted for the most prescribed antibiotics followed by amoxicillin, metronidazole and ampicillin / cloxacillin. The frequent use of this drug maybe due to their broad-spectrum activity and indication for most bacterial infections. Amoxicillin/clavulanate and metronidazole were reported as the most prescribed antibiotics combination in Libya [23], while gentamicin and cefuroxime were the most prescribed antibiotics in the University of Uyo Teaching Hospital in Nigeria [26]. The observed variations in antibiotic prescribing can be attributed to the pattern of disease and differences in microbial susceptibility in the study centres. Metronidazole, the third most utilized antibiotic in our study centre has been documented as commonly used in other secondary and tertiary health care facilities in Nigeria [27]. This may be due to its efficacy, broad spectrum anaerobic activity, low toxicity level and ready availability as well as affordability [28].
In the prescription of antibiotics, it is most often preferred to minimize the number of antibiotics per prescription in order to curtail the risk of interaction, resistance and cost to the barest minimum in order to achieve optimum clinical outcome as well as adherence.

In this study the average number of drugs per encounter was 3.71, this far exceeds the recommended WHO range of 1.6-1.8% indicating poor prescribing practice. This practice maybe ascribed to empirical antimicrobial use and lack of adherence to guidelines on rational prescribing. A high average number of drugs per encounter may also be indicative of high level of polypharmacy. Similar value of 3.7 as that recorded in this study has been reported both in Ghana and India [29,30]. A 100% prescription by generic name is expected by WHO. However poor adherence to this was observed in this study as only 38.0% of the total prescriptions were in generics. Generic prescribing has been reported to decrease cost and therefore encourage optimum adherence [31].

Conclusion

The study revealed that the University of Benin Health Centre had an average number of 3.71 drugs per encounter with antimicrobials accounting for 34.2%. Additionally, only 38.0% of the prescribed antimicrobials were in generics. The penicillins were the most prescribed followed by the cephalosporins (β-lactam) and the major indications for antibiotics were malaria fever, respiratory and gastrointestinal tract infections. The antimicrobial utilization pattern of the physicians in the study centre was not in compliance with the World Health Organization antibiotics prescribing indicators.

Conflict of Interest

No conflict of interest is associated with this work.

Contribution of Authors

We declare that this work was done by the author(s) named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. UFB supervised the work, analyzed the data and prepared the manuscript, VAO and MAA collected the data. SOE contributed to the preparation of the manuscript, JOA conceived and designed the study. All the authors read and approved the final manuscript.

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