Evaluation of knowledge, attitudes and practices of human healthcare students about antimicrobial drug use and resistance: a cross-sectional study in University of Maiduguri, Nigeria

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Abstract

Inappropriate consumption of antimicrobial drugs is the main cause of antibiotic resistance which is currently the most critical global public health challenge. This research aimed to evaluate knowledge, attitudes, and practices of antimicrobial drug use and resistance among 576 students. Data were collected through a questionnaire. Descriptive analyses were performed to characterize the sampled population. Ethical clearance and students' informed consent were obtained. Most of the students were within the age range of 21-25 years and have excellent knowledge of antimicrobial use. Also, most of them had very good knowledge of antimicrobial resistance. From the data analysed 445 (77.3%) agreed that students should get special training on the use of antimicrobials; 120 (20.8%) students agreed that education on the use of the antimicrobial drugs is necessary; 115 (20.0%) believed that prohibiting the use of antimicrobials without a valid prescription is a solution. The knowledge level on antimicrobial drug use and resistance was excellent 329 (57.1%). Most of the students' attitude as regards the usage of antimicrobials was found to be average. High rates of incorrect antimicrobial usage practices were noticed and the attitude was average. The development of an effective antimicrobial stewardship program is a necessity.

Keywords: Attitudes; Knowledge; Healthcare; Students; Antimicrobial usage

INTRODUCTION

The use of antimicrobial agents for the management of infections is increasingly challenged with the problem of antimicrobial resistance (AMR) which keeps escalating precariously in every part of the world. Antimicrobial resistance (AMR) compromises the ability to manage usual infections, leading to longer stays in health facilities, infirmity, protracted sickness, high-priced specialist care, and untimely death [1]. The incorrect use of antimicrobial drugs represents one of the main causes of antibiotic resistance. Without effective antimicrobials for the prevention and management of infections, complex surgical procedures become perilous [2]. In the healthcare facilities in Europe, the problem of resistance to

antimicrobial agents resulted in high death rates of up to 25,000 persons yearly with an amount of approximately €1.5billion each year [1]. United States Centers for Disease Control and Prevention showed that yearly about two million persons were inflicted with infections that are resistant to antimicrobial agents, and over twenty thousand persons were lost yearly as a consequence of these infectious diseases [3]. In Nigeria, infectious diseases accounted for about 67% of all mortality. There was increased resistance to most medications recommended for these diseases in the country [4]. A study recommended that efforts must be made in improving the rational prescription of antimicrobials among healthcare professionals in Nigeria [5]. Furthermore, the incidence of antimicrobial consumption has escalated with two in six prescriptions containing a wider-spectrum antimicrobial agent [6]. The irrational use of antimicrobial agents may be attributed to dearth of knowledge on the appropriate antimicrobials consumption by the caregivers [1]. Reports from an evaluation of antimicrobial drugs use in primary healthcare institutions in India and China highlighted an unacceptably high level of errors in antimicrobial prescriptions [7]. The incidence of antimicrobial resistance is greater among the caregivers as the healthcare providers are disposed to abuse antimicrobial agents without appropriate diagnosis or advice by the pharmacist [8]. The majority of the medical and allied healthcare University students usually recommends antibacterial agents to individuals and would abruptly discontinue drug administration when the condition improved without finishing the stipulated doses [9]. There are many projects (internationally, nationally, and locally) that are striving to enhance and encourage the correct administration of antimicrobial agents. It is crucial to intensify the enlightenment of the significance of the appropriate utilization of antimicrobial drugs for normal infectious

conditions among future healthcare providers [10].

On this premise, the study aim was to evaluate the knowledge, attitudes, and practices of human healthcare students of the University of Maiduguri, Nigeria about antimicrobial drug use and resistance.

EXPERIMENTAL METHODS

Study area. Borno State is geographically the largest and oldest state in the North-Eastern part of Nigeria with an estimated population of 2,596,589 in the 2005 census [11]. The state shares borders with the Republic of Niger to the North, Chad to the North-East, and Cameroon to the East. Within the country, its neighboring states are Adamawa, Yobe, and Gombe. The principal ethnic group in Maiduguri is Kanuri. Although English is the official language, Hausa and Kanuri are widely spoken. It has been the center for learning and commercial activities and full of tourist attractions [11].

Study design. This is a cross-sectional study conducted among undergraduate students of the University of Maiduguri in North-Eastern, Nigeria that were selected using simple random sampling. The study was carried out from November 2019 to February 2020.

Target population. The study population consisted of undergraduate students in the disciplines of Pharmacy, Dentistry, Medicine, Nursing, and Medical Laboratory Science.

Sample size determination. Based on the statistical formula of Fisher for a population greater than 10,000; α-level was set at 5% with a 95% confidence interval. The Confidence interval precision was fixed at 5% and standard normal deviant at 1.96. According to the assumptions above, the sample size estimate for this study was calculated as 384. The total number of healthcare students in the penultimate and final year in the University of Maiduguri was 1, 437 as at November, 2019. Since the population of these students was

lower than 10,000, a statistical formula by Araoye [12] was used. This is given as

$$nf = n/(1 + n/N)$$

where nf = Desired sample size

n = Sample size for population greater than 10,000 (384);

N = Estimate of the study population (1437)

Therefore, 361 was obtained as the minimum sample size required. To increase the power of the study, and considering the questionnaire's non-response rate, the sample size was increased by 60%, hence the number of students enrolled was 576. A proportionate quota sampling was conducted to determine the number of participants from each discipline as shown in Table 1. Medicine had the highest number, followed by nursing, pharmacy, medical laboratory science and the least was dentistry.

Eligibility criteria. Eligible for the study were medicine, dentistry, nursing, medical laboratory science, and pharmacy penultimate and final year students of the University of Maiduguri.

Instrument validation. Thorough investigations in the literature of earlier similar studies on knowledge, attitudes, and practices of human healthcare students on antimicrobial drug use and resistance were conducted. A structured questionnaire was designed and adapted to cover all the key points of the research. The validity of the content of the questionnaire was evaluated by distributing the questionnaires to sixty students recruited from same disciplines in University of Maiduguri as a pilot study for the validation process. After the pilot study, the responses from the questionnaires were analyzed with STATA 10 software package. Cronbach's alpha coefficient reliability test was used to assess the reliability and internal consistency of the items in the questionnaire. The mean of the internal consistency of the questionnaire was 0.83. The result of the test was 0.83, indicating the reliability of the questionnaire

for the main study. The students that were involved in the pilot study were exempted from the final analysis.

Subject selection. The information on the identification number of students, study year, and discipline were obtained from the students' Affairs Office. Selection by simple random sampling was used based on their identification numbers and grouped according to discipline and study year (Medicine and Dentistry, 500-600 levels; Pharmacy, Nursing, and Medical Laboratory Science, 400-500 levels).

Data instrument. The study instrument was written in English Language and contained thirty-three closed-ended questions under four sections. The first section is the demographic section comprising of four questions that were intended to collect data on gender, age, course of study, and level of study. The second section comprised sixteen questions that evaluate students' knowledge of antimicrobial drug use. This section assessed uses of antimicrobials, factors that promote the inappropriate use of antimicrobials, consequences of antimicrobials overuse, and reliable sources to access information on the use of antimicrobials amongst others. The third section contains five questions that evaluate students' knowledge of antimicrobial resistance including the potential causes of antimicrobial resistance, the extent of agreement on the routes of spread of antimicrobial resistance, measures to control antimicrobial resistance, and others. The fourth section evaluates students' attitudes/practice about antimicrobial resistance and has eight questions, including; whether students should get special training on the rational use of antimicrobials to mitigate antimicrobial misuse/abuse during their course of study and to ascertain if they have plans to campaign on proper use of antimicrobials amongst others. Sections two and three had the options of 'agree', 'disagree' and 'do not know'. In section four, the choices include 'yes', 'no' and 'undecided'.

Data collection. The validated self-administered questionnaire was distributed to the students who had been preselected according to the random sample obtained from the Students Affairs Office. The validated questionnaires were distributed to the students at the end of their lecture periods. The researcher explained comprehensively to the students the objectives of the study. The students were also assured of the confidentiality of the information provided. The students who were willing to participate in the research were asked to indicate their signatures on the consent form before filling the questionnaire. Involvement in the study was made voluntary, and no benefits or incentives were offered to students.

Statistical analysis. Responses from the questionnaire were entered into a Microsoft Excel spreadsheet and rechecked for accuracy before analysis. Data analysis was done using Statistical Package for Social Sciences software version 20.0. Descriptive analyses were performed to characterize the sampled population. The results in Tables 2, 3, 4, and 5A were obtained by the number of students that choose agree for each question and divided by the total number of students enrolled, likewise for those students that do not agree or do not know. For Tables 2,3,4 and 5B, the results were gotten by adding the number of students that choose to agree for all the questions under Tables 2,3,4, and 5A, and a range was set based on the highest number obtained.

Ethical consideration. The approval to conduct the research was obtained from the Ethical Committee of the University of Maiduguri with reference number: VCDNA-814/Vol.64. Also, written informed consent was sought and obtained from the students before proceeding with the study. Participation of students in this work was voluntary and compensation was not granted.

RESULTS

Distribution of students by socio-demographic characteristics. The majority of the students (69.8%) were males and 134 (23.3%) were third-year students, the fourth-year students have the largest number (36.6%) while the fifth and sixth-year students were 179 (31.1%) and 52 (9.0%) respectively. Most (69.62%) of the students were within the age range of 21-25 years with an average age of 24.62±2.42 years (Table 2).

Assessment of students' knowledge of antimicrobial drug use. Table 3a shows the details of the frequency and distribution of students' responses to questions regarding antimicrobial drug use. Following the grading scale devised, the details of frequency and distribution of the students according to the knowledge of antimicrobial drug use were described in Table 3b.

Evaluation of students' knowledge on causes of antimicrobial resistance. Table 4a indicates potential causes of antimicrobial resistance as shown above. Most of the students agreed that use of antimicrobials for self-limited viral infections, poor awareness of prescribers/dispensers on antimicrobial drug resistance and lack of restrictions on antimicrobial usage among others were responsible for antimicrobial resistance.

Frequency and distribution of grading of the students 'according to the knowledge of antimicrobial resistance. Based on the scale used, the results obtained for knowledge of antimicrobial resistance among the students were shown in Table 4b. One third of the students had very good knowledge of antimicrobial resistance. About one fifth of these students have excellent knowledge.

Evaluation of routes of transmission of antimicrobial resistance. Table 5a described the various routes of antimicrobial resistance transmission.

Frequency and distribution of grading of the students 'according to the knowledge of the spread of antimicrobial resistance. Table 5b indicates the spread of knowledge of antimicrobial resistance. Almost one half of these student had good knowledge of spread of antimicrobial resistance and about one fifth had excellent knowledge.

Table 1: Showing the number of students required from each discipline for the study

Serial No	Discipline	Number of penultimate and final year students	Number of students required for the study
1.	Medicine	365	146
2.	Dentistry	71	29
3.	Pharmacy	330	132
4.	Nursing	360	144
5.	Medical Lab Science	311	125
	TOTAL	*1, 437*	*576*

Table 2: Distribution of Students by Socio-Demographic Characteristics

Socio-demographic characteristics		Number of students	Percentage of students
Discipline	Medicine	146	25.3
	Nursing	144	25.1
	Medical laboratory science	125	21.7
	Pharmacy	132	22.9
	Dentistry	29	5. 0
Gender	Female	174	30.2
	Male	402	69.8
Level of Study	300 Level	134	23.3
	400 Level	211	36.6
	500 Level	179	31.1
	600 Level	52	9.0
Age (Years)	≤ 20	20	3.5
	21 – 25	401	69.6
	26 – 30	140	24.3
	> 30	15	2.6

Table 3a: Knowledge of antimicrobial drug use and spread of antimicrobial resistance

Factors	Factors	1 N (%)	2 N (%)	3 N (%)
Antimicrobials are used for the treatment of	Bacterial Infections	513 (89.1%)	11(1.9%)	52(9.0%)
	Viral Infections	393(68.2%)	107(18.6%)	76(13.2)
	Fungal Infections	452(78.5%)	77(13.4%)	47(8.1%)
	Protozoal Infections	433(75.2%)	88(15.3%)	55(9.5%)
Factors that may promote the inappropriate use of antimicrobials	Poor counseling of patients	469(81.4%)	64(11.1%)	43(7.5%)
	Poor knowledge of prescriber/ dispenser	462(80.3%)	74(12.8%)	40(6.9%)
	Patient self-medication	470(81.6%)	64(11.1%)	42(7.3%)
	Inadequate advice to patients	453(78.6%)	75(13.1%)	48(8.3%)
Consequences of antimicrobials overuse	Antimicrobial resistance	458(79.5%)	74(12.9%)	44(7.6%)
	Adverse drug reactions	326(56.6%)	156(27.1%)	94(16.3%)
	Better patient outcome	137(23.8%)	329(57.1)	110(19.1%)
	Drug Abuse/Addiction	311(54.0%)	126(21.9)	139(24.1%)
Sources to access information on the use of antimicrobials	Lecture Notes	275(47.7%)	165(28.7%)	136(23.6%)
	Newsletters	107(18.6%)	351(60.9%)	118(20.5%)
	Official Books	394(68.4%)	101(17.5%)	81(14.1%)
	Treatment Guidelines	445(77.3%)	80(13.9%)	51(8.8%)

1 = Agree; 2 = Disagree; 3= Do not know

Table 3b: Distribution of the students according to the knowledge of antimicrobial drug use

Knowledge level	Number of students	Percentage of students
Poor	31	5.4
Good	109	18.9
Very good	107	18.6
Excellent	329	57.1
Total	576	100.0

Table 4a: Potential Causes of Antimicrobial Resistance

Causes of Antimicrobial resistance	1 N (%)	2 N (%)	3 N (%)
Use of antimicrobials for self-limited viral infections	385 (66.8)	112(19.4)	79(13.8)
Use of antimicrobials with a broader than necessary spectrum despite the availability of susceptibility data	469 (81.4)	47(8.2)	60(10.4)
Use of antimicrobials for shorter than the standard duration	358(62.2)	134(23.2)	84(14.6)
Lack of restrictions on antimicrobial usage	357(62.0)	139(24.1)	80(13.9)
Poor awareness of prescribers/Dispensers on antimicrobial drug resistance	400(69.4)	91(15.8)	85(14.8)

1 = Agree; 2 = Disagree; 3= Do not know

Table 4b: Knowledge of antimicrobial resistance

Knowledge level	Number of students	Percentage of students
Poor	127	22.1
Good	152	26.4
Very good	192	33.3
Excellent	105	18.2
Total	576	100.00

Table 5a: Evaluation of routes of transmission of antimicrobial resistance

Spread of Resistance factor	1 N (%)	2 N (%)	3 N (%)
1Mutation of Bacteria genes due to exposure to Antimicrobials	352 (61.1)	120(20.8)	104(18.1)
2Resistance organisms from healthcare facilities to the community	376 (65.3)	84(14.6)	116(20.1)
3Resistance spread from an infected person to another person through the air	293(50.9%)	186(32.3%)	97(16.8%)

1 = Agree; 2 = Disagree; 3= Do not know

Table 5b: Knowledge of the spread of antimicrobial resistance

Knowledge level	Number of students	Percentage of students
Poor	206	35.8
Good	261	45.3
Excellent	109	18.9
Total	576	100.0

Table 6a: Distribution of attitude of the students regarding the usage of antimicrobial drugs

S/N	Measure	Yes N(%)	No N(%)	Undecided N(%)
1	Students should get special training on the rational use of antimicrobials to mitigate antimicrobial misuse/abuse during their course of study	445(77.3)	53(9.2)	78(13.5)
2	Do you have plans to campaign on the Proper Use of Antimicrobials?	413(71.7)	67(11.6)	96(16.7)
3	Do you check the expiry date of antimicrobials before use?	393(68.2)	84(14.6)	99(17.2)
4	Do you consult a prescriber/dispenser before you buy/use Antimicrobials?	253(43.9)	274(47.6)	49(8.5)
5	Do you take left-over Antimicrobials from a friend/family member/colleague because you feel their ailment is the same as yours	433(75.2)	113(19.6)	30(5.2)

Table 6b: Attitude of students to antimicrobial usage

Attitude level	Number of students	Percentage of students
Poor	115	20.0
Average	373	64.7
Excellent	88	15.3
Total	576	100.0

Table 7: Distribution of effective solutions to contain antimicrobial resistance

	Solutions	*Frequency	Percentage
1	Greater education for prescribers and dispensers on Antimicrobial Drug use	429	21.2
2	Establishment of a National Antimicrobial Resistance Surveillance Service	407	19.9
3	Prohibit the use of Antimicrobials without a valid prescription	406	19.9
4	Good hygiene through hand washing, environmental cleaning and wearing protective clothing	402	19.7
5	Reduction of antimicrobial Usage for Outpatients	397	19.3
	Total	2041	100

*Multiple responses

Students' attitude/practice regarding the usage of antimicrobial drugs. Table 6a. shows students' attitudes regarding the usage of antimicrobial drugs.

Distribution of students' grading on attitude. The students' attitude based on score between 3-4 points in this section was described in Table 6b. Most of the students have average attitude to antimicrobial drug use.

Solutions to tackle antibiotic resistance. It was ascertained that from the responses of the students they thought antimicrobial resistance can be tackled by the various ways suggested in this study (Table 7). Most of the responses of the students was on greater education for prescribers and dispensers to mitigate antimicrobial drug resistance. This was followed by establishment of a national antimicrobial resistance surveillance service and the least was the practice of good hygiene and reduction of antimicrobial usage among outpatients.

DISCUSSION

Findings have shown that good knowledge of undergraduate healthcare students regarding issues of antimicrobial consumption and resistance could improve interventions directed at enhancing the antimicrobial use as well as the content of antimicrobial resistance [13].

In this study, it was found that most of the human healthcare students were males and within the age group of 21 - 25 years with the majority of them in 400 Level. These findings coincide with previous studies on knowledge and practices in the use of antibiotics among a group of Nigerian university students [14].

In the current study, most of the students had excellent knowledge regarding antimicrobial drug use. This finding was consistent with the previous report that the knowledge of the majority of the students was adequate [15]. However, these results were inconsistent with other studies that showed moderate–poor knowledge [16]. The studies observed that this group of individuals has adequate knowledge due to the type of training received as potential healthcare providers. However, more than three-quarters of the students agree that poor counseling of patients, poor knowledge of prescriber/dispenser, patient self-medication, and inadequate advice to patients were factors that may promote the inappropriate use of antimicrobials. This is because some of the patients do not have appropriate knowledge about their disease conditions, some do not seek medical advice instead they visit quack doctors who are ignorant of the ailments while some visit patent

medicine store for drug prescription refills. Also, some practiced self-medication based on their past experiences with previous diseases. Antimicrobial self-medication is defined as the procurement and self-consumption of the antimicrobial agent to manage an observed infectious condition [17]. This practice which has been found in both developed and low resource countries is most prominent among developing countries due to the poverty-stricken status of the citizens and weak health facilities [9]. Factors that could encourage self-medication among university students have been identified as assumed knowledge of diseases and their treatments, prior experience on the use of antimicrobial agents, lack of time to visit physicians, and poor financial status [18].

The current findings revealed that irrational consumption of antimicrobial drugs may be responsible for drug resistance leading to worldwide problem as understood by majority of the participants. This agrees with previous studies conducted in Greece whereby the majority of the students affirmed that antimicrobial resistance is a global problem [19]. The most preferred sources of information on the use of antimicrobial as suggested by the students were treatment guidelines followed by the official book. Contrary to an earlier study that the most common way was text books and other guides [20].

In this study, most of the students did not practice the correct use of antimicrobial agents. Our finding is contrary to other studies among human healthcare students whereby majority of the students consulted a doctor before starting an antimicrobial drug [21]. Larger proportion of the students took left-over antimicrobials from a friend/family member/colleague. This is comparable to the studies conducted in Egypt where 75% of the students took leftover antimicrobials from a friend, family member or colleague [22]. Sharing of antimicrobial agents with persons

who have related symptoms of ill-health may further promote self-medication as shown in this study. This is in keeping with a study done amongst students in Sri Lanka [23]. Possession of unused antimicrobial drugs may signify that either the amount bought or the doses prescribed were higher than the required doses. Secondly, this could be that the course of therapy was discontinued without the prescribed doses completed [1,24]. Similar studies were conducted in Ethiopia and China [24,25]. A study reported that pharmacists should counsel patients on the risks associated with an incomplete course of antimicrobial therapy and the practice of the use of left-over antimicrobials which is injurious [26].

To avoid antimicrobial resistance, some solutions were suggested by the students. In this study, greater education for prescribers and dispensers on antimicrobial drug use was ranked first among other suggested solutions. This was to create awareness targeting the medical professional, prescribers, and pharmacists regarding the rules and laws of antimicrobial prescription and standard treatment guidelines that should be followed [27]. The establishment of a national antimicrobial resistance surveillance service is also suggested which will monitor the use of antimicrobial in the country. This can help in combating antimicrobial resistance. The control of antimicrobial resistance cannot be addressed by medical professionals and scientists alone [1]. Continuous education is essential to enable healthcare providers to learn the need for rational prescription practices and the importance of evidence-based prescription. Also, the general population and other stakeholders have a central role to play. Furthermore, a study conducted reveals that the government should consider antimicrobial resistance as a public health priority issue [2].

Conclusion. This study has demonstrated that human healthcare students at the University of Maiduguri have excellent knowledge of

antimicrobial use and resistance. Despite the excellent knowledge, high rates of incorrect antimicrobial usage practices were observed. These findings warrant the development of an effective and comprehensive antimicrobial stewardship program in undergraduate education.

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