KNOWLEDGE, ATTITUDE AND PRACTICE OF CLINICAL MEDICAL STUDENTS TOWARDS ANTIBIOTIC RESISTANCE, ANTIBIOTIC USE AND ANTIBIOTIC RESIDUE IN ZARIA METROPOLIS

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ABSTRACT

Antibiotic resistance is a growing global health threat especially in developing countries like Nigeria. Major drivers of antibiotic resistance include limited knowledge, poor awareness of proper antibiotic use and irrational prescription practices. The study assessed the knowledge, attitude, and practice (KAP) of clinical medical students regarding antibiotic use, resistance, and residue. A questionnaire was administered to 260 Clinical medical students of Ahmadu Bello University, Zaria, Nigeria. Associations between independent and dependent variables regarding Antimicrobial use (AMU) and antimicrobial resistance (AMR) were measured using Chi-square tests with a significance level set at 0.05.Of the 260 respondent (57%) were females and (77.7%) are single. The age group of 31-35 had a good (100%) knowledge, and the age group of 15-20 had poor knowledge (100%), with a statistically significant ($P \leq 0.00$) difference. Notably, 98.55 of the respondents use antibiotics against bacterial organisms and 184 (70.8%) against viral organisms. 184 (70.8%) participants agreed antibiotics treat viral infections. The majority (95.8%) of the participants are aware of antibiotic resistance. Antibiotics treat fungal infections, according to 162 (62.3%) participants. A total of 219 (84.2%) affirm that misuse of antibiotics contributes to antibiotic resistance. When symptoms disappear 197(75.8%) of the students discontinue treatment. The study revealed that 67 (25.8%) of the respondents rated their knowledge as excellent, 189 (72.7 %) as good, and 4 (1.5%) as poor. This study revealed that most medical students were aware and knowledgeable about antibiotic resistance. There is, therefore, a need for continuous education and stewardship interventions.

INTRODUCTION

Antibiotics are a class of drugs that are used to treat bacterial infections. They work by targeting bacterial cells and disrupting their ability to grow and multiply (Douafer *et al*., 2019). According to Ullah & Ali (2017), antibiotics can be classified based on their chemical structure, mechanism of action, and spectrum of activity. There are several classes of antibiotics based on their structure, such as penicillin, cephalosporins, macrolides, tetracyclines, aminoglycosides, and quinolones. Based on their mechanism of action, there are several categories of antibiotics, such as cell wall synthesis inhibitors, protein synthesis inhibitors, DNA synthesis inhibitors, and membrane disruptors (Etebu & Arikekpar, 2016). Antibiotics can also be classified based on

their spectrum of activity. There are two main categories of antibiotics based on their spectrum of activity: broad-spectrum antibiotics and narrow-spectrum antibiotics (Ullah & Ali, 2017).

This can be achieved in several ways, such as by disrupting the bacteria's ability to synthesize essential molecules, damaging the bacterial cell wall, or disrupting the bacterial cell membrane. According to Mohr (2016), antibiotics are used to treat a wide range of bacterial infections. They are essential for the treatment of serious infections such as pneumonia, sepsis, and meningitis, as well as other infections such as urinary tract infections, ear infections, and skin infections. According to Oberoi *et al.* (2015), antibiotics are used before surgical procedures to prevent infection and to treat infections that develop after surgery. Antibiotics are also used in veterinary medicine to treat bacterial infections in animals. They are used to treat infections in livestock and to prevent the spread of disease in animal and fish populations (Meek *et al.*, 2015).

Antibiotics have also been used to promote growth and improve animal productivity in animal production. This method involves the administration of antibiotics at low doses to animals to enhance their growth rate and improve their feed conversion efficiency (Gustafson & Bowen, 1997). According to Van Boeckel *et al.* (2015), around 80% of antibiotics consumed globally are used in animal production for non-therapeutic purposes, such as growth promotion and disease prevention. The authors further noted that the use of antibiotics as growth promoters results in the development of antibiotic-resistant bacteria in animals, which can be transmitted to humans through the consumption of animal products and can also be released into the environment through their urine and feces. Antibiotic resistance is the ability of bacteria to resist the action of antibiotics and continue to survive and multiply even when treated using a high dosage of antibiotics (Gustafson & Bowen, 1997). The abuse and misuse of antibiotics has led to the emergence of antibiotic-resistant bacteria, which is a major public health concern (Serwecińska, 2020). Several actions drive the development of antibiotic resistance. It arises due to the overuse, misuse, and inappropriate use of antibiotics.

Antibiotics have also been associated with the development of antibiotic residues in animal products. Antibiotic residues are the remnants of antibiotics in animal products such as meat, milk, and eggs (Robles-Jimenez *et al.*, 2021). These residues can pose a risk to human health, especially if consumed in excessive amounts. Antibiotic residues can lead to allergic reactions, toxicity, and the development of antibiotic resistance in humans. Proper use of antibiotics is essential to prevent the spread of antibiotic-resistant bacteria and to ensure that antibiotics remain effective for future generations (Katakweba *et al.*, 2012).

In a study exploring the knowledge, attitude and practice of medical students regarding antibiotic use and antibiotic resistance in Malaysia revealed that 90% of the students desire more education on the appropriate use of antimicrobials, and only 33% perceived their knowledge to be adequate in some fundamental principles of antimicrobial use (Haque *et al.*, 2019). The attitudes and perceptions regarding antimicrobial use and resistance among medical students in Italy showed that approximately 20% of respondents regarded antibiotics as appropriate for viral infections, whereas 15% discontinued the prescribed treatment once the symptoms had disappeared Yang *et al.*, 2016). Therefore, medical students in training are a particularly relevant population when it comes to emphasizing the importance of rational antibiotic prescription and the fight against antibiotic resistance. Thus, enlightening future doctors and medical students about antibiotic usage and dosage constitutes an important strategy to reduce bacterial drug resistance (Rather *et al.*, 2017).

MATERIALS AND METHODS
STUDY AREA
The study was conducted in Ahmadu Bello University, Zaria which lies between 11° .03' 60.00" N and Longitude: 7° 41' 59.99" E in Zaria, Kaduna State Nigeria. Zaria lies between latitude: 11°6 and 11°40.61" N and Latitude: 7 43' 21.72" E (Greenwich 2000 GMT, 2021) and at an altitude of 686m above sea level. It has an annual rainfall of about 1055 mm, an average temperature of 24.5 °C and a mean relative humidity of 43.6 %. Zaria is a very large, heterogeneous city whose metro area population is 766,000 (Abubakar *et al.*, 2017).

STUDY DESIGN
A cross-sectional survey was conducted using a closed-ended questionnaire to assess knowledge, attitudes, and practices of medical clinical medical students regarding antibiotic use, resistance and residue. The survey was carried out over a period of 3 months (June 2024 to August 2024) during the 2023/2024 academic session.

STUDY POPULATION
The target population included Clinical student medical, (Medical, Nursing science and Veterinary student) at Ahmadu Bello University, Zaria.

VARIABLES
The dependent variables of the study are knowledge, attitude and practice. While the independent variables are the respondent age, sex, marital status, Sex, age group, faculty, and undergraduate level.

INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria for this study were all student who are in their clinical years in Ahmadu Bello University, and those who are willing to participate in the study. Students who are not willing, non-clinical students were excluded from the study.

SAMPLE SIZE DETERMINATION

The sample size was estimated using the formula of Kothan (2004).

Based on the data collected; N = 1,091, P = 0.5%,

A= 0.03, Z = 1.96, R = 80,   n = 260

$$n = \frac{P(1-P)}{A^2/z^2 + \frac{P(1-P)}{N}}$$

MESUREMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE ITEM SCALE

A 10 item scale questions was used to score for knowledge, attitude and practice and assumed as high, moderate and low, with the overall score for each respondent >70% as high, 50-69% as moderate and less than 50% as low based on their respective score for knowledge, attitude and practice.

DATA ANALYSIS

Data were analyzed using Chi-square test to determine associations between socio-demographic factors and KAP regarding antimicrobial use (AMU) and antimicrobial resistance (AMR). A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

A total of 260 clinical students participated in the study, comprising 59 (22.7%) medical students, 139 (53.5%) nursing science students and 62 (23%.8) veterinary medicine students.

Out of the 260 students, (43%) are males and (57%) are females. Based on the age group, (0.4%) of the students are within the age group of 15-20yrs, (53.5%) within 21-25yrs, (34.6%) within 26-30yrs, (6.9%) within 31-35yrs and (4.6%) were above 35yrs of age. Base on faculty categorization, 59 (22.7%) were medical students, 139 (53.5%) Nursing science and 62 (23.8%) were Veterinary students, of which 106 (40.8%) were 400 level, 105 (40.4%) 500 level and 49 (18.8%) 600 level students. Among the respondent's 202 (77.7%) were single and 58 (22.3%) were married (Table I).

KNOWLEDGE RELATED TO ANTIBIOTICS USE, RESISTANCE AND RESIDUE

Majority 256 (98.5%) of the respondents use antibiotics against bacterial organisms, while 184 (70.8%) and 162 (62.3%) participants use them to treat viral and fungal infections, respectively. Of the 260 students (95.8%) were aware of antibiotic resistance and (84.2%) of the students believe that the use of under dose of antibiotics result in antibiotics resistance. Bacteria is spread from animals to humans, according to the belief of 170 (65.4%) of the students. 139 (53.5%) of the students believe resistant pathogens result from antibiotics in meat and milk, while 253 (97.3%) of the students believe self-medication results in antibiotics resistance and 88.5% of respondent believe antibiotics resistance is a public health problem (Table II).

ATTITUDE RELATED TO ANTIBIOTICS USE, RESISTANCE AND RESIDUE

Among the respondents164 (96%) of the students use antibiotic when sick, while 205 (80%) use antibiotics for prophylaxis. Of the 260 student in the study 226 (87%) of them advocate for sale of non-prescribed antibiotics where 146 (56%) and 98 (38%) of the students, prescribe antibiotics to their sick friends and family members respectively. The administration of double doses of antibiotics at a time speed up the cure of infections is the believe of 218 (84%) of the respondents and also 78 (31%) of the students believe that missing dose result in antibiotic resistance. Expensive antibiotics have fewer side effects compared to the cheaper ones is the believe of 217 (85%) of the students, while 98 (38%) of the students giving medication to sick family members (Table III).

PRACTICE RELATED TO ANTIBIOTICS USE, RESISTANCE AND RESIDUE

Regarding antibiotic usage practice, 188 (73%) of respondents reported using antibiotics based on a doctor's prescription, while 171 (66%) keep left over antibiotics for further use until when they fail sick again. Only 212 (82%) of the respondents reported completing the course of treatment. About 217 (84%) of the respondents checked the expiration date, while 115 (44%) purchase formerly prescribed antibiotic for the same illness. The use of antibiotics for helminthic infection is practiced by 201 (77%) of the respondents. Antibiotics are administrated against fungi infection by 199 (77%) of the students while 214 (83%) take antibiotics as prophylactic. The use of more than one antibiotic at a time is practiced by 158 (61%) of the students, while 241 (93%) of the students take doctors recommended dose (Table IV).

ASSOCIATION OF RESPONDENT DEMOGRAPHICS IN RELATION TO KNOWLEDGE, ATTITUDE AND PRACTICE SCORE

Association of respondent's demographics in relation to knowledge, revealed that age (p= 0.00, df=4) and marital status (p=0.015, df=1) of the students were statistically

significant (Table V). With regards to the association of

TABLE II: RESPONDENTS' KNOWLEDGE RELATED TO ANTIBIOTICS USE, ANTIBIOTIC RESISTANCE AND ANTIBIOTIC RESIDUE

knowledge questions	Response	Freq. (%)	Response	Freq. (%)
Antibiotics are used against bacterial organisms?	Yes	256 (98.5)	No	4 (1.5)
Antibiotics are used against viral infections?	Yes	184 (70)	No	76 (29.2)
Antibiotic resistance occurs when bacterial develop defenses against the antibiotics design to destroy them?	Yes	249 (95.8)	No	11 (4.2)
Antibiotics are used to treat fungal infection?	Yes	163 (62.3)	No	97 (37.3)
Antibiotics used for durations shorter than that prescribed contributes to antibiotic resistance?	Yes	219 (84.2)	No	40 (15.8)
Antibiotics treatment may be discontinued when symptoms disappeared?	Yes	197 (75.8)	No	63 (24.2)
Bacteria which are resistant to antibiotics can be spread from animals to humans?	Yes	170 (65.4)	No	89 (34.6)
Presence of antibiotics in meat and milk products could results in development of resistant pathogens?	Yes	139 (53.5)	No	120 (46.5)
Self-medication is one of the main causes of antibiotic resistance?	Yes	253 (97.3)	No	7 (2.7)
Antibiotics resistance is a world-wide public health problem?	Yes	230 (88.5)	No	30 (11.5)

respondent's demographics in relation attitude, sex (p=0.026, df=1) of the students were statistically significant (Table V). With regards to the association between practice and demography of the respondent, all the factors had a good influence on the students practice but with no statistical significant difference (Table V).

TABLE I: DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Variables	Sub Variable	Frequency (%)	
Sex	Male	148	(57)
	Female	112	(43)
Age	15-20 years	1	(0.4)
	21-25 years	139	(53.5)
	26-30 years	90	(34.6)
	31-35 years	18	(6.9)
	> 35	12	(4.6)
Faculty	Medicine	59	(22.7)
	Nursing Science	139	(53.5)
	Vet. Medicine	62	(23.8)
Level	400 Level	106	(40.8)
	500 Level	105	(40.4)
	600 Level	49	(18.8)
Marital Status	Single	202	(77.7)
	Married	58	(22.3)

DISCUSSION

The study revealed that 50% of the students had good knowledge of AMU and AMR, 20% moderate knowledge and 30% poor knowledge. With regards to their attitude 20% of the students had moderate attitude towards AMU and AMR and 80% had poor attitude. Based on their practice towards AMU and AMR 40% of the students had good practice, 10% had moderate practice and 50% had poor practice.

A strategic goal for the reduction of AMR is educating the next generation of health care professionals. Inappropriate AMU and associated risk of AMR is an increasing public health problem globally (Prestinac *et al*., 2015).

In modern medicine and animal production, antimicrobial agents (AMAs) are very important and emergence of resistance results to many problems to mankind all over the world. To reduce AMA resistance, misuse and abuse of AMA should be avoided (Llewelyn *et al*., 2017).

Appropriate and justified use of AMA should be inculcating into the student's habit. In developing countries, such as Nigeria AMA misuse is facilitated by their availability as over-the-counter sale, without prescription, and through unregulated supply chain (Ayukekbong *et al.*, 2017).

TABLE III: RESPONDENTS' ATTITUDE RELATED TO ANTIBIOTICS USE, ANTIBIOTIC RESISTANCE, AND ANTIBIOTIC RESIDUE

Attitude questions	Response	Frequency (%)	Response	Frequency (%)
Do you use antibiotics when you feel sick?	Yes	164 (96)	No	96 (34)
Do you take antibiotics to protect yourself against infection even when you're not sick?	Yes	205 (80)	No	51 (20)
Do you recommend antibiotics to a sick friend?	Yes	146 (56)	No	51 (20)
Will you advocate for the sales of non-prescribed antibiotics drug?	Yes	226 (87)	No	111 (20)
Do you think costly antibiotics are more effective?	Yes	149 (57)	No	98 (43)
Will you buy an antibiotics drug that has no expiry date?	Yes	255 (98)	No	4 (20)
Do you agree missing one or two antibiotics dosages doesn't contribute to antibiotics resistance?	Yes	180 (69)	No	78 (31)
Do you agree using double dose of antibiotics can speed up the cure of the disease?	Yes	218 (84)	No	46 (16)
Do you think taking costly antibiotics have fewer side effects?	Yes	217 (85)	No	39 (15)
If a family member feels unwell, do you usually give them an antibiotic?	Yes	98 (38)	No	163 (62)

TABLE IV: RESPONDENTS' PRACTICE RELATED TO ANTIBIOTICS USE, ANTIBIOTIC RESISTANCE, AND ANTIBIOTIC RESIDUE

Practice questions	Response	Frequency (%)	Response	Frequency (%)
Do you consult a doctor before taking an antibiotic?	Yes	171 (66)	No	88 (34)
Do you save the remaining antibiotic for next time you get sick?	Yes	171 (66)	No	88 (34)
Do you complete the full course of antibiotics treatment?	Yes	212 (82)	No	47 (18)
Do you check the expiration date of the antibiotic before taking it?	Yes	217 (84)	No	42 (16)
Will you buy the same formerly prescribed antibiotic for the same illness without doctor's prescription?	Yes	115 (44)	No	144 (56)
Will you use antibiotic against helminthic infection?	Yes	201 (77)	No	58 (23)
Do you use antibiotic against fungi infection?	Yes	199 (77)	No	58 (23)
Do you take antibiotics routinely as prophylactic?	Yes	214 (83)	No	44 (17)
Do you use more than one antibiotic at a time?	Yes	158 (61)	No	99 (39)
Do you take the recommended dose of antibiotics prescribed to you?	Yes	214 (93)	No	15 (7)

TABLE V: ASSOCIATION OF RESPONDENT'S DEMOGRAPHICS IN RELATION TO KNOWLEDGE, ATTITUDE AND PRACTICE SCORE

Characteristics		Knowledge		Chi Square	Attitude		Chi Square	Practice		Chi Square
		Good	Poor	p-Value	Good	Poor	p-Value	Good	Poor	p-Value
Sex	Female (148)	141(95.3)	7(4.7)	0.76	137 (93.2)	10(6.8)	0.026*	138 (93.9)	9(2.1)	1.00
	Male (112)	111 (99)	1 (1)		111 (99.1)	1 (0.9)		111 (99)	1 (1)	
Age	15-20	0 (0)	1 (100)		1 (100)	0 (0)		1 (100)	0 (0)	
	21-25	135(97.1)	4 (2.9)		134 (96.4)	5 (3.6)		129 (92.8)	10 (7.2)	
	26-30	88 (97.7)	2 (2.3)	0.00*	84 (94.4)	5 (5.6)	0.756	85 (95.5)	4 (4.5)	0.720
	31-35	18 (100)	0 (0)		18 (100)	0 (0)		18 (100)	0 (0)	
	> 35	11 (91.6)	1 (8.4)		11 (91.6)	1 (0.4)		11 (91.6)	1 (8.4)	
Faculty	Medicine (59)	58 (98.3)	1 (1.7)		57 (98.3)	1 (1.7)		56 (96.6)	2 (3.4)	
	Nursing Science (139)	132 (95)	7 (5)	0.127	130 (93.5)	9 (6.5)	0.160	130 (93.5)	9 (6.5)	0.687
	Vet. Medicine (62)	62 (100)	0 (0)		61 (98.4)	1 (1.6)		58 (93.5)	4 (6.5)	
Level	400L (106)	102(96.2)	4 (3.8)		103 (97.2)	3 (2.8)		100 (94.3)	6 (5.7)	
	500L (105)	101(96.1)	4 (3.9)	0.383	99 (94.3)	6 (5.7)	0.583	97 (92.3)	8 (7.7)	0.395
	600L (49)	49 (100)	0 (0)		46 (95.8)	2 (4.2)		47 (97.9)		
Marital status	Married (202)	199(98.5)	3 (1.5)	0.015*	195 (97)	6 (3)	0.73	187 (93)	14 (7)	0.202
	Single (58)	53 (91.4)	5 (8.6)		53 (91.4)	5 (8.6)		57 (98.2)	1 (1.8)	
Taken AB within 1yr?	Yes (246)	238(96.7)	8 (3.3)	1.00	234 (95.5)	11 (4.5)	1.00	232 (94.6)	13 (3.4)	0.190
	No (14)	14 (100)	0 (0)		14 (100)	0 (0)		12 (85.7)	2 (4.3)	
Antibiotic Training	Yes (196)	151(97.8)	5 (2.6)	0.14	189 (96.4)	7 (3.6)	0.470	186 (94.9)	10 (5.1)	0.370
	No (64)	61 (95.3)	3 (4.7)		59 (93.7)	4 (6.3)		58 (92)	5 (8)	
Antibiotic Perception	Excellent	65 (97)	2 (3)		61 (91)	6 (9)		60 (89.6)	7 (10.4)	
	Good	183(96.8)	6 (3.2)	0.935	183 (97.3)	5 (2.7)	0.082	180 (95.7)	8 (4.3)	0.156
	Poor	4 (100)	0 (0)		4 (100)	0 (0)		4 (100)	0 (0)	

Total no. of each variable is 260, *AB = Antibiotics, L= Level * represent statistically significant variables where P-value ≤ 0.05

Antibiotic resistance is a world-wide public health problem and was the asserted by 88.5% of the respondents in this study which is similar to a similar study among the medical students in a tertiary care hospital in Nepal where majority (88.6%) of the students were aware of the global problem of antimicrobial resistance (Ruchi, 2019). The finding was also similar to the study done in Congo among medical students and practicing medical doctors in which 85.4% participants said antibiotics resistance is an important global problem (Thriemer *et al.*, 2013). Also with regards to awareness of antibiotic resistance, a surprising (86.4 %) have heard the term "antibiotic resistance" in the study of Popoola *et al.*, which is significantly higher than the 38 and 56 % reported by the WHO and Chukwu *et al*, respectively (WHO, 2015; Chukwu *et al.*, 2020). It further buttresses observations by the WHO that people with higher level of education are more likely to have heard about antibiotic resistance (WHO, 2015).

In this study the higher the class level the higher the knowledge, even though there was no significant difference (P=0.383). This is because the senior students (600 Level) would have received more knowledge through classes, workshops, and training than freshman. Similar findings in China in 2013, revealed improved knowledge and attitudes toward antibiotic use as grades of the participants increased (Huang *et al.*, 2013). The results of the present study, along with those reported in previous studies; indicate that study levels have a significant influence on KAP levels. Recently, WHO has also embraced the role of undergraduate training in prudent prescribing (WHO, 2012).

The present study revealed that (98.5%) of the student are aware that antibiotics are used to treat bacterial infections, this similar to the findings of Zulu *et al.*, in Zambia in 2020, where (99.2) of the students in the study are also aware that antibiotics are used to treat bacterial infections. In Nigeria, Ajibola *et al.* (2018) found similar findings.

The perception that missing one or two antibiotics dosages do not contribute to antibiotics resistance by students in this present study is par with the study of Khan *et al.*, in 2015 where a reasonable number of medical students in Southern Indian teaching hospitals believed skipping of doses would not contribute to resistance. The study done by Shubha *et al.* (2013) and Zafar (2008) demonstrated that there is increased incidence of self-medication in dental and university students which is similar to this study where 226 (87%) advocated for the sales of non-prescribed antibiotics drug. The findings of this study revealed that (87%) of the student's advocate for use of non-prescribed antibiotics, this finding is higher than the findings of Evangeline *et al.*, in Uyo in 2017 who noted that about (24.8%) of the respondents in their study felt they should be able to get antibiotics from a pharmacy without a prescription. The findings of this study are also higher than

that of the study in Namibia where only 15% of the respondents had obtained antibiotics without a doctor's prescription (Pereko *et al.,* 2015). The findings of this study may be due to the uncontrolled access to purchase of antibiotics without prescriptions in Nigeria.

This study is contrary to the study of Precha *et al*. (2024) in Thailand where some (19.06%) of the students obtained antibiotics from friends, family, residual drugs, and the internet (Precha *et al*., 2004). A number of studies claimed that >50% of antibiotics are sold or purchased without a valid prescription (Cars & Nordberg, 2005). The above studies are contrary to the study of Khan *et al*. (2013) where a large proportion of pharmacy students in this study rarely used no prescribed antibiotics. The reason for the increased incidence of self-medication in developing countries can be due to the availability of these antibiotics over-the-counter, prescription on demand, high cost of the hospitals or healthcare consultation and dissatisfaction with medical practitioners (Grigoryan *et al.*, 2008). In this study 44% of the students self-prescribed antibiotics without a doctor's prescription, which is similar to the study in Yemen where 66.40% of the students had used antibiotics without a prescription (Halboup *et al*., 2021). These two studies are contrary to the study of in Bangladesh and Nepal where up to 90% of students had taken antibiotics as prescribed by their doctor (Shah *et al*. 2019; Marzan *et al*., 2021).

The reported prevalence of self-medication for this survey is (96%), relatively higher than the (23 %) recorded by the WHO for Nigeria in 2015, and (31.1 %) recorded in another study in Nigeria by Chukwu *et al*. (WHO, 2015; Chukwu *et al*., 2020). This prevalence of self-medication in this present is also higher than the (44.8 %) obtained by Enato *et al*. and (45 %) obtained by Onanuga and Temedie in earlier studies in 2011. When asked about reasons for self-medication, the most common reasons were convenience, limited access to doctors and health professionals, and financial constraint. This correlates with reasons identified in other similar studies in Nigeria and other LMICs (Do *et al*., 2021; Babatunde *et al.,* 2016).

In this study 212 (82%) of the student complete the full course of antibiotics treatment which is similar to the study of Mate *et al*. (2022) which reported the use of complete course of antibiotics prescribed by the doctor. A survey done in an Indian university by Virmani *et al*. (2017) observed similar finding amongst dental students (73.1%), MBBS students (67.4 %) but less 31.50% in nursing students (Virmani *et al*., 2019). Another study done by Dawnji (2018) amongst second year medical students reported the same findings in 84.9% of participants. Mahajan *et al*. (2014) discussed medical education strategies (such as incorporating updated guidelines and resistance patterns into the curricula, promoting trust and collaboration among health workers and

students, and integrating feedback mechanism) to enhance KAP about AMU and AMR. Undergraduate training in Pharmacology must include protocol for antibiotic use (Nathwani & Davey, 1999). Emphasis must be given to infections control (Davey &Garner, 2007) and simple measures like hand hygiene should be inculcated in day-to-day life (Wester *et al*., 2002). The medical curriculum should involve strategies to empower knowledge and to change attitude and practice toward AMA use and AMR as well. Bacteria which are resistant to antibiotics can be spread from animals to humans was the assertion of (65.4%) of the students in this present study which is contrary to the study of Popola *et al* where only 20.1 % think that antibiotic-resistant bacteria can spread from person to person.

This study showed that 171(66%) of the students save the remaining antibiotics for the next time they get sick and also 115 (44%) will buy the same formerly prescribed antibiotic for the same illness without doctor's prescription. This finding is similar to the findings, in which some students in the United Kingdom had begun treatment using antibiotics left over from a prior course of treatment without obtaining a new prescription (Dyar *et al*., 2018). This phenomenon was nonetheless more common among students in the health sciences than among students from the other disciplines. It is possible that these health science students are more likely to have family members who work in health professions, thus providing them with better access to drugs without a prescription. Researchers suggest that knowledge among health science students influences their likelihood of taking antibiotics without a prescription (Odetokun *et al*., 2019; Al-Taani *et al*., 2022). This study revealed that 217 (84%) of the students check the expiration date of the antibiotic before taking it. This is similar to the findings of study of Evangeline *et al*., in Uyo in 2017 where majority (92.8 %) of the respondents agreed to looking at the expiry dates of antibiotics before using them. This finding is also similar to that of a study on antibiotic use in some Nigerian communities which reported that (93.3%) respondents demonstrated positive attitudes in looking at the expiry dates of antibiotics before using them (Auta *et al*., 2013).

In this study 75.8% of the respondents discontinue antibiotics treatment when symptoms disappeared; this is similar to the study of Precha *et al*. (2024) in Thailand where the majority 64.11% of the students stopped taking antibiotics when their symptoms had disappeared. Studies involving students in Bangladesh (41.95%), the United States (38.00%), and Nepal (85.70%) reported the same result (Shah *et al*., 2019; Marzan *et al*., 2021; Tran *et al*., 2021). However, several instances of improper antibiotic use were discovered among health science and non-health science university students in Thailand (Precha *et al*., 2024) where 48.27% of all the students kept leftover antibiotics for

future use, the above study concur with the present study where 66% of the students save the remaining antibiotic for next time when they get sick. In a study in Nigeria, more than half of the students had kept leftover antibiotics for future use, and 55% had not finished their antibiotic courses (Igbeneghu, 2013). The majority 40.76% and 42.61% of veterinary and non-veterinary students respectively in Bangladesh managed leftover antibiotics by throwing them away, while 19.33% and 16.925 keep them for use when they get sick again (Chapot *et al.*, 2021).In conclusion the study revealed that 50% of the students had good knowledge of AMU and AMR, 20% moderate knowledge and 30% poor knowledge. With regards to their attitude 20% of the students had moderate attitude towards AMU and AMR and 80% had poor attitude. Based on their practice towards AMU and AMR 40% of the students had good practice, 10% had moderate practice and 50% had poor practice. The study recommends that enlightenment on the possible adverse effects of indiscriminate use of antibiotics within the campus and beyond be undertaken by clinicians and also the assessment of KAP of non-medical students in ABU, Zaria should be carried out.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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