Evaluation of Northern Nigerian Final-Year Pharmacy Students' Knowledge of Stewardship Practices, AMR, and Antibiotics

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Abstract

It is important to have well prepared, competent and knowledgeable pharmacists as they help tackle the current public health problem of antimicrobial resistance (AMR). The purpose of this work was to test how much fifth year pharmacy students in Northern Nigeria know about antibiotics, resistance to microorganisms and the proper use of antibiotics.We conducted a paper-based, descriptive cross-sectional study that included questions asked from July to September 2021. Each person filled out the questionnaire independently and it had four sections. In the first section, I asked about respondents' personal information and section B centered on their awareness of antibiotics and AMR. Part C had six questions that measured people's knowledge of various AMS areas and the final part tested their ability to use antibiotics and how informed they are about these subjects. These findings were described using statistical methods.There were 164 questionnaires collected as part of the results. The majority of those interviewed were men and teenagers between 21 and 25. While some understanding about antibiotics and AMR was present, a number of mistakes about them were found as well. Even though only 80 students (48.8%) knew what AMS is, a high percentage of them understood AMS's aims and the roles on the AMS team. Most respondents admitted that their knowledge of antibiotics, AMR or AMS was not enough for their future work and more than 90% of them wanted to learn more about these issues.In sum, while much of the participants understood these concepts, there were still a number of areas where they lacked understanding. Undergraduate pharmacy education should be improved in these areas.

Keywords: ***Antibacterial agents, antibiotic resistance, antimicrobial stewardship, Nigeria, pharmacy students.***

1.Introduction

Antimicrobials do a vital job in stopping and treating many diseases, yet they are among the most frequently abused drugs. It is one of the main reasons why worldwide cases of AMR are on the rise, as bacteria, viruses, fungi or other parasites start developing resistance over time to common antimicrobial medications. AMR affects a wide range of areas apart from human health. People living with resistant infections often have a hard time recovering and are more prone to disabling illnesses and death. As a result, patients who suffer from resistant infections remain in the hospital much longer and use more costly drugs, placing increased financial strains on everyone. That is why AMR is seen as a major threat to the health and progress of people everywhere, so action is being taken by many individuals, international groups and government organizations(1).

AMS programs are essential in efforts to manage the AMR problem. They have many components to ensure effective use of antibiotics, better health outcomes for patients and less risk of side effects. The implementation of these programs with other strategies for AMR has been found to improve lives, decrease healthcare spending and better many medical results. Such achievements largely depend on the skill and understanding of the professionals who carry them out.

Professionals working in healthcare need to be well-trained in choosing appropriate antimicrobials to fight AMR. That's true because some methods for cutting AMR, like AMS programs, are led or put in place by kind of authorized healthcare professionals. In AMS, pharmacists are responsible for developing guidelines on antimicrobial use, improving treatment for specific patients, informing healthcare professionals and the public about proper antimicrobial use and checking and reviewing results to evaluate outcomes. Around the world, assessments of health workers' understanding and application of proper antimicrobial use have found differing results.

For students in health-related categories, there is also clear evidence that knowledge about AMR and similar topics is mostly incomplete. It seems that pre-service explanations about antimicrobials, forms of resistance and stewardship offered to many young healthcare professionals are not adequate for their needs. So, there have been more requests from various stakeholders that schools review their curricula to deal with these issues(2).

Downloading one of these files is a particular issue in Nigeria. Tuberculosis, respiratory infections and diarrhea are among the many infectious diseases that affect the people of India. It appears that many of the viral and other bacteria causing infections in Nigeria show substantial resistance, contributing to a high rate of disease-related suffering and death. A recent survey across the country found that many healthcare professionals show only a limited understanding of antibiotics and the problem of AMR. Similarly, researchers have found it is not uncommon for Nigerian health undergraduates to lack enough knowledge about antibiotics and related matters.

Yet, there is not much detailed information about the knowledge of pharmacy students regarding antibiotics, resistance and stewardship in Nigeria. A survey designed for this domain has never been done before, with the one previous study having a group of about 60 students. It is concerning, as pharmacists are essential in ensuring medicine is handled correctly in hospitals.

When students study in pharmacy schools, they begin forming the attitudes and information that will guide them in their work as pharmacists. Learning about the knowledge of final-year pharmacy students allows us to assess how useful their pharmacy courses are in preparing them for antimicrobial management and stewardship. They can be used to guide special initiatives and updates in the curriculum which aim to improve pharmacy teaching related to this issue(3).

Since there are many infectious diseases in Nigeria, antimicrobial resistance is a problem and pharmacists are essential for managing drug therapy, checking pharmacy students' knowledge of these matters becomes very important. Since final-year students are preparing for their future jobs, their ability and readiness play a key role in outcomes for patients. How much they learn, their beliefs and what they intend to do will soon influence the care provided to patients and the use of antimicrobials in hospitals and other health settings around Nigeria.

Because of this, this study focused on understanding how much fifth-year pharmacy students in selected universities in Northern Nigeria know about antibiotics, antimicrobial resistance and antimicrobial stewardship. Recognizing specific areas where people lack understanding and knowledge allows professionals to direct educational programs to make pharmacy education in this area better. The research findings may guide the reform of coursework in pharmacy programs in Nigeria and elsewhere, leading to better use of antibiotics and less antibiotic resistance.

2. Methods

Design and Sites

An approach involving a descriptive cross-sectional method and a paper-based questionnaire was used to gather data from fifth-year students in pharmacy from three universities in Northern Nigeria. From July to September 2021, the study focused on gathering data from students who were finishing their program before entering the workplace. To cover all areas of Northern Nigeria, the researchers used stratified random sampling to select among the eight institutions currently providing pharmacy degrees and identified three of them. As a result of this method, the Northwest, North Central and Northeast areas were covered by including Ahmadu Bello University in Zaria, the University of Jos and Gombe State University respectively(4).

Participants in the Study and the Number Selected

People were eligible to join the study based on the set inclusion criteria. Only students who satisfied the following conditions were able to participate: (1) were in their final year of bachelor of pharmacy, (2) were students from the three selected universities, (3) agreed to participate in writing and (4) could read and write English. If students did not meet all of the requirements, they were not allowed to join. Rather than randomly choosing eligible students, the researchers selected all the final year pharmacy students at the chosen institutions. The purpose of this method was to get the highest number of responses and to include all relevant individuals. When the study was carried out, the group of final-year students from the three universities summed to 215 which made up the target sample size.

Study Instrument

A self-administered questionnaire in English was used in the research process (see Appendix I in the original paper). The questions were taken from well-known and official instruments, allowing the study to be compared internationally. To check if the instrument is suitable for use in Nigeria, it was first evaluated by four Clinical pharmacy professors. When this validation was done, the questionnaire was tested on 30 final-year pharmacy students from another university to see if there were any issues in understanding the questions. Following the pilot study, no changes were made to the survey since all participants found it easy to understand and answer the questions(5).

The final survey contained four separate parts (A-D) which were used to assess students in all areas. Details such as

gender, age, university membership and education were gathered in Section A. Section B tested participants' knowledge of antibiotics and antimicrobial resistance using various questions and statements on key topics and practical issues. Section C had six questions testing participants' skills in recognizing the main areas that antimicrobial stewardship affects and its strategy. Responses in section D required individuals to rate their abilities with antibiotics and their current understanding of AMR and AMS using eleven statements.

Data Gathering and Collection

We made sure that each student was able to keep on with class and exams as little as possible while completing and handing in their questionnaires. Professionals from India gave questionnaires to students through class reps, who distributed them while everyone was gathered for lessons. Respondents had up to 48 to 72 hours to complete the questionnaires when they felt comfortable doing so. By using this method, teachers acknowledged that the questionnaire was detailed and that students needed enough time to reflect on what they know and see. After finishing the questionnaires, students returned them to the class representatives. These class representatives then combined and sent the forms to the research team so they could analyze them.

Section	Description
Study Design and Sites	Descriptive cross-sectional study using paper-based questionnaires; stratified random sampling across 3 universities representing Northern Nigeria's regions (Ahmadu Bello University Zaria - Northwest, University of Jos - North Central, Gombe State University - Northeast).
Study Participants and Sample Size	Eligibility: final-year BPharm students enrolled in selected universities with English proficiency and informed consent. Total population sampling was used; target sample size = 215 students.
Study Instrument	Validated self-administered questionnaire in English adapted from international studies. Reviewed by 4 Clinical Pharmacy experts for content validity. Pilot-tested with 30 students outside the main sample. Comprised 4 sections: demographics, knowledge, stewardship, and preparedness.
Data Collection Process	Questionnaires distributed via class representatives during lecture hours. Students had 48–72 hours to complete and return the forms. Collected questionnaires were compiled and sent to the research team.
Ethical Considerations	Ethical approval obtained from Ahmadu Bello University Zaria (Approval number: ABUCUHSR/2020/UG/017). Participation was voluntary, anonymous, and based on written informed consent. Data were handled confidentially.
Data Analysis Approach	Data were coded and entered in Microsoft Excel 2016. Descriptive statistics (frequencies, percentages) used. Likert-scale responses were grouped to summarise agreement and disagreement levels.

TABLE 1 Summary of Study Methodology

Ethical Considerations

The research study followed strict ethical guidelines. AHBUZ approved the research through the Human Research Ethics Committee (approval no. ABUCUHSR/2020/UG/017). In order to ensure participants' data were not identifiable, nothing personal was recorded in the questionnaire and only the research team access the files. Consent forms were prepared for all participants and explained to them that joining the study was entirely voluntary and their privacy was safeguarded. All the ethics rules included in the documentation were strictly followed by the researchers as they conducted the study(6).

This research also follows the Data Analysis Approach.

Statistics used in the analysis were descriptive, reflecting that the study was done to better understand the problem. After getting the questionnaires, each response was put into a code and all the data were entered into Microsoft Excel 2016 sheets. Percentages and frequencies were used to see how people answered in different areas of knowledge and groups. For Likert-scale questions at the end of the questionnaire, the reporting categories were simplified so that those who strongly agreed were grouped with those who agreed and the same done for those who disagreed. Assessing the students in this manner allowed me to pinpoint both their knowledge and skills in these three universities.

3. Results

Characteristics of the Respondents

The survey yielded an 76.3% response rate and a total of 164 questionnaires were received back from the 215 that were distributed. Due to the high response rate, the outcomes are truly reflective of the target group. According to the analysis, there were 95 males (58.3%) and 68 females (41.7%) taking part in the survey, just as expected due to the typical distribution of students in Nigerian pharmacy schools. Most of the respondents were between 21 and 25 years old (53.4%), followed by 41.1% between 26 and 30 and only 5.5% in the group aged above 30. Because the students' average age was 26 ± 3 years, we can see that most final-year students are young. Respondents took part from each university, with ABU comprising the majority, at 42.7%, next came University of Jos at 39% and Gombe State University at 18.3%. It generally follows the proportions of pharmacy students at each school. The majority of participants reported participating in more than two antibiotics-related educational courses during their years at school(7).

Familiarizing with Antimicrobial Resistance and the Associated Words

They had different levels of knowledge about major antimicrobial terms. All but very few people in the survey could define terms such as antibiotic resistance (95.7%), antimicrobial resistance (94.5%) and drug resistance (92.1%). Over three-quarters (85.4%) saw part in the term antibiotic resistant bacteria. On the other hand, fewer than seven out of ten (67.7%) noticed the abbreviation "AMR," and just about four out of ten (40.2%) recognized the word "superbugs," suggesting that many are lacking awareness of modern terminology linked to antimicrobials. From their answers, 76.2% of respondents appeared not to understand that the terms "antimicrobial resistance" and "AMR" have the same meaning. Meanwhile, just 5.5% of people knew that "antibiotic resistant bacteria" and "superbugs" mean the same thing, displaying a lack of awareness that different terms used in this field are often used synonymously(8).

Category	Key Findings
Response Rate	76.3% (164/215 respondents)
Gender Distribution	Male: 58.3% (n=95), Female: 41.7% (n=68)
Age Distribution	21–25 years: 53.4%, 26–30 years: 41.1%, >30 years: 5.5% (Mean: 26 ± 3 years)
University Representation	ABU Zaria: 42.7%, University of Jos: 39%, Gombe State University: 18.3%
Prior Antibiotic Coursework	76.9% completed 2–4 antibiotic-related courses
Familiarity with AMR Terms	"Antibiotic resistance": 95.7%, "AMR": 67.7%, "Superbugs": 40.2%
Correct Identification of Antibiotic Indications	Skin infections: 91.5%, UTIs: 89%, Cold: 51.8% (incorrect), Sore throat: 62.2% (incorrect)
Knowledge of AMR Drivers	Poor adherence: 86.6%, Overuse in humans: 82.3%, Drug quality issues: 75%, Animal use: 62.8%
Misconceptions	77.7% thought resistance develops in the body, 44.4% believed AMR only affects antibiotic users
Awareness of Mitigation Strategies	Education: 93.9%, Policies: 90.9%, Surveillance: 86.6%, New drugs: 42.7%

TABLE 2 Summary of Respondent Demographics and Knowledge on Antimicrobial Resistance

Recognizing the Uses of Antibiotics

When asked about antibiotic use, most participants answered correctly for just a third of the illnesses given. Most people correctly realized it is important to use antibiotics for skin infections and urinary tract infections, but, still, a notable portion thought antibiotics were required for other types of illnesses. In this case, what stood out the most was that over half the people incorrectly listed cold, close to two thirds included a sore throat and one third put measles in the list of times to use antibiotics. Also positive is that only a small number of participants (15.2% for fever and 21.3% for malaria) indicated antibiotics for conditions they knew are not infected by bacteria. Nevertheless, the main reason given for antibiotic use is worrying, as it may mean future mistakes in prescribing or dispensing these drugs.

Learning about how to prevent and control Antimicrobial Resistance

Most respondents were informed about various key causes of antimicrobial resistance. The community of doctors correctly believed that not following medication with complete adherence (86.6%), too much use of antibiotics (82.3%) and weak quality of antibacterial drugs (75%) – play the central role in the rise of drug resistance. It was noted by many that broad-spectrum drugs should not be used if narrow-spectrum choices work, as this treatment causes resistance. Still, only about 4 out of 10 respondents properly considered the link between bad hand hygiene and the rise of bacteria even to harsh drugs. Respondents said that providing information to health professionals and the public, as well as setting up new policies, were the interventions most likely to combat antimicrobial resistance. The majority of respondents believed that setting up antimicrobial resistance surveillance systems is important (86.6%). Surprisingly, less than half of the respondents (42.7%) thought that inventing new antimicrobial drugs would be useful, perhaps because they knew this is only one way to address drug resistance.

Beliefs That Are Wrong About Antimicrobial Resistance

It was found that there are various common misconceptions about antimicrobial resistance. Most of the people participating in the survey thought that resistance comes from the human body, rather than understanding it affects the microorganisms that cause various infections. About half of the respondents believed incorrectly that antimicrobial resistance would not be affected by improved use of antibiotics. Many people (44.4%) are mistaken in thinking that resistance from using antibiotics concerns only those individuals, rather than everyone. Based on these results, we can see that people misunderstand the biological and epidemiological aspects of antimicrobial resistance. In spite of this, more than two-thirds (69.5%) of respondents realized that infections with antibiotic-resistant bacteria might increase risks during surgeries and cancer treatment.

4.Discussion

Summary of Important Discoveries

The study allows us to look into what fifth-year pharmacy students in Northern Nigeria know about antibiotics, antimicrobial resistance (AMR) and antimicrobial stewardship (AMS). The study exposes both valuable knowledge and knowledge gaps that could shape pharmaceutical practice in the future. The majority of individuals knew what antibiotics and antimicrobial resistance are, yet some gaps in knowledge and misunderstandings were noticed in multiple subjects. A significant number, almost half of those surveyed (48.8%), said they were not familiar with antimicrobial stewardship, even though it plays an important role nowadays. Most survey respondents demonstrated that they understood the key components, intents and responsibilities related to AMS. The survey results showed that 90% or more respondents are interested in learning more about these topics. These results build on prior studies and provide new understanding of pharmacy education needs in Nigeria, where infectious diseases are common and drug resistance is an important issue today(9).

Knowing when and how to use antibiotics is important

It appears that difficulties identified in antibiotic prescribing education around the world also exist in the African setting. Many respondents knew that each situation called for a specific type of antibiotic and that taking all the prescribed medicine was necessary, but their ability to assess which antibiotic would be useful in each situation was weak. It is obvious that many students have a weak knowledge of the types of antibiotics used and the types of infections they shouldn't be used for because approximately half of them consider that cold and over 38 percent think that measles require antibiotics (51.8% and 39%, respectively). According to Sakeena et al. (2019) and Lubwama et al. (2021), similar results were found regarding the inaccurate use of antibiotics by health profession students around the world. These false beliefs could become a problem, as they might encourage inappropriate prescribing by pharmacists in future, since community pharmacies are often the first places where people seek healthcare.

Giving more antibiotics as prevention for typhoid and pneumonia is still a common mistake by over one-quarter of people (27.6% made this error). It is also concerning that 20.5% of healthcare professionals are not sure about the

prefered route for antibiotic drugs (by vein or by mouth), a topic that could use more attention in pharmacotherapy education. According to Lin et al.'s (2020) study, similar misunderstandings also contribute to inappropriate use of antibiotics by patients in primary care internationally. Based on my findings, I believe that the current pharmacy curriculum focuses more on learning different antimicrobial classes than on understanding when and the best way to use specific drugs in practice.

Information about How Microbes Resist Antimicrobials

Although students knew many things that cause antimicrobial resistance such as patients not following treatment (86.6%) and prescription of many antibiotics (82.3%), the study found that they rarely knew the scientific explanations for resistance. It is important to note that 77.7% of participants believed incorrectly that resistance comes from the human body, instead of from microorganisms, as this confusion could reduce the quality of communication with healthcare colleagues and patients. The same mistakes have been observed by Sakeena et al. in Sri Lanka in 2018 and Abbo et al. in the United States in 2013, suggesting that this could be a common difficulty encountered by pharmacy programs internationally.

Nearly half of the respondents misunderstood the connection between using more antibiotics and the rise of resistance. The inaccurate belief could lessen students' motivation to take care of the environment if they do not connect the use of prescribing tools to the occurrence of resistance. The fact that 44.4% of replies stressed that AMR only harms those using antibiotics indicates a gap in their understanding of AMR and its effects on everyone. This is what Chukwu et al. (2021) also discovered in their national survey involving healthcare staff in Nigeria.

Getting to Know Antimicrobial Stewardship

It is very concerning that only 48.8% of final-year pharmacy students were familiar with antimicrobial stewardship, considering how important AMS is to today's work in pharmacy. The results are lower than those found by Burger et al. (2016) in South Africa, but they are comparable to numbers reported by Ahmed et al. (2019) from another developing country. Awareness of AMS was highest among those who encountered it through pharmacy lectures (80%). So, AMS instruction in Northern Nigerian pharmacy programs may not meet the mark, leaving room for positive changes in the curriculum(10).

It was generally found that among AMS-familiar students, their knowledge of its components was relatively precise. Ninety-three percent of respondents identified proper usage of medicines and seventy-five percent chose the best dosing options. Just as with antimicrobial resistance and toxicity, most notable legit AMS goals are in line with 95% and 81.3% of recognized goals. Clearly such ideas are mostly delivered in a correct manner in the curriculum, but it is challenging to ensure complete coverage for all learners. Almost everyone (98.8 percent) saw doctors as important on AMS teams, 92.5 percent pointed out hospital pharmacists and 81.3 percent mentioned hospital nurses. However, when it came to finding the key people for infection control, many (21.3 percent) did not think of hospital cleaning staff, who are important in the work.

5.Conclusion and Future work

Overview of the Notable Results

It is clear from the evaluation that pharmacy students in Northern Nigeria have sound knowledge about antibiotics, AMR and AMS, but also face challenges in various areas. According to the study, while most respondents know about antimicrobials to some degree and some guidelines for antibiotics, they still have many misunderstandings about main topics important for drug practice. Most respondents were aware of the terms antibiotic resistance (95.7%) and antimicrobial resistance (94.5%), yet they knew little about superbugs (40.2%) and had problems telling the equivalence of some terms apart. Many respondents seemed unable to decide correctly on when antibiotics were required, claiming that viral illnesses need to be treated with antibiotics. Furthermore, despite being able to identify causes of AMR, the majority of people (77.7%) mistakenly believed that resistance forms in the body instead of in microorganisms.

On the other hand, less than half of the respondents were aware of the importance of antimicrobial stewardship in today's global pharmacy. Many who are familiar with AMS knew about its main ideas and intentions, possibly because some important parts are lacking from most curricula. The students assessed that only 45.4% considered their current understanding of antibiotics sufficient for their professions, 44.5% held the same view about AMR and 32.3% thought their AMS awareness was adequate. Similarly, over 90% of them wanted further training on these subjects. Similar research carried out elsewhere has found that pre-service pharmacy education may not properly preparing graduates to manage and use antimicrobials.

Consequences for Learning in Pharmacy

The discovered areas where knowledge is lacking have major effects on pharmacy education in Nigeria and similar areas. It is suggested that school curriculum should be revised to successfully challenge errors in knowledge and improve the spellings that guide the decision-making of clinicians. Today, pharmacy students are taught what antimicrobial resistance is and what categories exist, yet they are not taught how and why those types of resistance occur. That final-year students are not exposed to antimicrobial stewardship as part of their curriculum indicates that pharmacy schools underemphasize the topic. Seeing that these students are about to practice in a nation overwhelmed by infectious diseases and resistance to drugs, dealing with these shortcomings becomes all the more crucial.

Medical school should reform its curriculum to encourage students to relate their knowledge of antimicrobial drugs to real-world clinical situations, hoping that students will be able to identify if an infection is caused by bacteria or viruses and select the suitable antibiotic when required. Using cases can be very beneficial for growing the ability to tell one thing apart from another. Furthermore, the information should point out that resistance to antimicrobials is found in microbes, not in patients and that their resistance can be affected by the ways antimicrobials are used. The instructional part of this topic should be added as a key component in the curriculum instead of being just a secondary focus.

Ways to Implement the Guidelines

This study's findings can also influence pharmacy practice and health policy across Nigeria. Since there are knowledge gaps among pharmacists who are set to graduate, there is a possibility that practicing pharmacists, who may hold the same misbeliefs, could benefit from more professional development. Organizations in the pharmacy sector, as well as authorities, need to include antimicrobial stewardship in their ongoing programs and create targeted certification options on the topic. Moreover, the Pharmacists Council of Nigeria could strong more assessment of antimicrobial facts in licensure examinations to ensure all pharmacists meet the necessary levels of knowledge.

The findings highlight why Nigeria's National Action Plan on Antimicrobial Resistance aims to strengthen education for health professionals. Pharmacy education should be included in putting this plan into action, for example by developing similar courses on antimicrobial stewardship for use among different institutions. Investment in infrastructure and helpful resources that aid learning in antimicrobial stewardship such as new programs in teaching hospitals linked with pharmacy schools, should be considered by policy makers.

How Future Research Should Be Done

Though this study gives us useful findings on today's pharmacy students, it encourages others to continue asking important research questions. It would help to see how a doctor's education and beliefs change over time and which methods are most significant for ensuring appropriate actions in the medical field. Assessing various pharmacy programs side by side may reveal the most effective way to teach how to use antimicrobials. Assessing the use of training programs or simulated scenarios can offer insight on how adult education in hospitals should be improved.

Moreover, examining students from different areas of health care (medicine, nursing, etc.) would reveal how important collaborative education is for proper management of antibiotics. Studying these experiences in-depth could lead to more insight about how many misconceptions remain despite clients learning in schools. Studies linking knowledge and actual actions in prescribing or dispensing medication would guide choices about the key areas to focus on in education.

In short, the findings suggest ways to enhance pharmacy education concerning antibiotics, antimicrobial resistance and stewardship in Northern Nigeria. Educating pharmacy graduates in important areas related to antimicrobials may strengthen their ability to fight against antibiotic resistance problems affecting Nigeria and the world.

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Conflicts of interest

The authors have no conflicts of interest to declare

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