An Assessment of Knowledge, Attitude, and Practice of Medical Professionals on Factors Related to Antimicrobial Resistance in Three (3) Selected University Teaching Hospital Complexes in Sierra Leone: A Cross-Sectional Analytic Study

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Abstract

Although the growing increase of AMR is a major problem everywhere, developing nations like Sierra Leone are particularly at higher risk because of their limited resources to combat the problem. Medical Professionals are recognized as important determinants of antimicrobial abuse. To evaluate factors related to antimicrobial resistance patterns, a cross-sectional study was undertaken among 376 Medical Professionals. Doctors, nurses, pharmacists, laboratory Personnel and community health officer from three Sierra Leone University Teaching Hospital Complexes in Sierra Leone, formed the study population. KAP dimensions were assessed, and differences between groups were investigated, using descriptive statistics tests. The study highlighted the socio-demographic factors of health professionals (age, gender, profession, qualification, and years of experience) that were associated with antibiotic resistance training ($p < 0.05$). In the area of attitude towards antibiotics, 54% (203) and 72.9% (274) of study participants recommended that pharmacy staff be at their workstations to deliver services and dispense antibiotics prescribed by authorized prescribers as recommended by the Ministry of Health. Out of the total survey participants, 54.5% suggested antibiotics for laboratory-confirmed diseases. To prevent antibiotic resistance, 72.9% of survey participants advised patients to finish antibiotics. This study revealed the need for pharmacy staff to always be available to provide services

and dispense antibiotics. Healthcare professionals must be monitored to combat AMR. More research is needed to understand and improve antibiotic stewardship practices in Sierra Leone.

Introduction

Antimicrobial resistance (AMR) is a significant public health challenge worldwide, with the potential to cause morbidity, mortality, and economic burden [1, 2]. This resistance undermines the effectiveness of antimicrobial medications, making it harder and sometimes impossible to treat infections that were once treatable, threatening to reverse decades of gains in reducing infectious disease morbidity and mortality [3, 4]. The emergence and spread of resistant microorganisms, especially superbugs, have significant implications on patient care, healthcare systems, and society at large. Research have quantified AMR's health cost, and economic burden, with conclusions ranging from drug-bug resistance's impact on hospital mortality to AMR's worldwide economic impact [5]. AMR is estimated to cost the world $10 trillion by 2050 and kill 10 million people yearly if adequate efforts are not taken [6]. In the year 2019, it was observed that sub-Saharan Africa (SSA) had the greatest mortality rate (23.5 deaths per 100,000) associated with AMR [7].

The causes of AMR are multifaceted and interconnected. Antibiotic overuse and misuse in humans and animals, inadequate infection prevention and control procedures, and poor sanitation and hygiene standards all contribute to the rapid development of resistance [3, 4]. AMR is also linked to inadequate regulation of high-quality antimicrobial agents and their misuse. [8] Furthermore, unrestricted access to antibiotics, imported resistant strains due to increased worldwide travel, and the discharge of non-metabolized medicines or their residues into the environment due to unsanitary circumstances all contribute to AMR, further complicating efforts to contain and manage the problem [9].

In Sierra Leone, the incidence of AMR is high, and reports indicate that it is linked to poor infection control practices and inadequate use of antibiotics (13). To address this problem, it is essential to assess the knowledge, attitudes, and practices (KAP) of medical professionals towards AMR and its related factors. This study aimed to assess the KAP of medical professionals on factors related to antibiotic resistance patterns in three selected University Teaching Hospitals Complexes in Sierra Leone.

The assessment of KAP is crucial for designing and implementing effective educational and interventional programs to promote appropriate antibiotic use and reduce AMR. Previous studies have shown that improving the KAP of healthcare professionals can lead to positive changes in their prescribing behavior and reduce the incidence of AMR [5, 10]. An extensive knowledge gap regarding the proper administration of antibiotics was found when researchers previously investigated the KAP of Chinese undergraduates [10], which has some influence on the doctors in their career [10].

Antibiotic resistance is a global public health concern, with increasing rates of resistance observed in many countries. Sierra Leone is no exception and faces significant challenges in managing antibiotic resistance. Understanding these factors is crucial in developing effective strategies for managing antibiotic resistance and reducing its impact on public health. This study adopted a cross-sectional analytic design, and data was collected using structured questionnaires. The study population included medical professionals such as doctors, nurses, and pharmacists. The study was conducted in three selected University Teaching Hospitals Complexes in Sierra Leone, based on their high patient load and availability of laboratory facilities for AMR testing. Purposive sampling was used to select a sample of medical

professionals who meet the inclusion criteria. This study was conducted in three selected University Teaching Hospitals Complexes in Sierra Leone" to evaluate the knowledge, attitude, and practice of medical professionals on factors related to antibiotic resistance patterns in Sierra Leone. However, there is limited information on the KAP of medical professionals towards AMR in Sierra Leone. Therefore, this study is timely and relevant, as it will provide baseline information for designing effective interventions to combat AMR in the country. This study is particularly important because it has provided insights into the factors that contribute to antibiotic resistance in the Sierra Leone setting, which can inform the development of tailored interventions to address the problem. In conclusion, this study is important, as it has provided valuable information on the KAP of medical professionals towards AMR in Sierra Leone. The findings of the study will inform the development of interventions to improve antibiotic use and reduce AMR in the country.

Hypotheses

In this study, we hypothesized that antibiotic resistance is a significant issue in these three institutions. We believe that some medical practitioners' knowledge, attitudes, and behaviors contribute to antibiotic use and the development of antibiotic resistance. We also speculated that healthcare professionals may lack knowledge of, or have a bad attitude toward, antibiotic agents. These might have a negative impact on how antibiotics are recommended in these settings.

Materials and Methods

Study Design

A cross-sectional study design was used to collect data at a single point in time to assess medical professionals' KAP and associated factors.

Study Population

The study population consisted of medical professionals, including doctors, nurses, pharmacists, and laboratory technicians, who were currently working in three selected University Teaching Hospitals Complexes in Sierra Leone at the time of data collection.

Study Settings

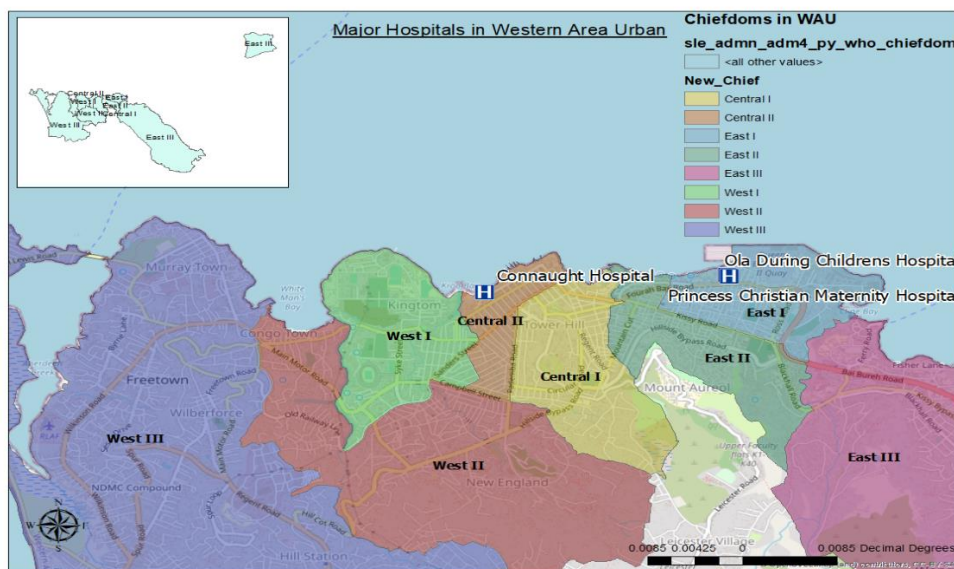The study was conducted in three selected University Teaching Hospitals Complexes in Sierra Leone (Figure 1).

Figure 1. Map of the Study Sites (Connaught Hospital, PCMH and ODCH)

Sample Size Calculation

The sample size was calculated using the formula for cross-sectional studies, which takes into account the expected prevalence of the outcome of interest, the level of precision desired, and the design effect. A total of 376 medical professionals were included in the study.

Sample Selection

The multistage sampling technique was used in this study. In the first stage, the three selected University Teaching Hospitals Complexes in Sierra Leone were selected. In the second stage, departments within each hospital were selected. In the third stage, medical professionals were selected from each department using a random sampling technique.

Inclusion and Exclusion Criteria

The inclusion criteria for this study were medical professionals who were currently working in the selected University Teaching Hospitals Complexes in Sierra Leone and had been working for at least six months. The exclusion criteria were medical professionals who were on leave at the time of the study or who refused to participate. We also excluded medical professionals who were working in the other hospitals of the University Teaching Hospitals Complexes but not in the three selected hospital.

Study Variables

The study variables included demographic characteristics of medical professionals, knowledge of antibiotic resistance, attitude towards antibiotic use, and practice of antibiotic use.

Data Collection

Data were collected using a structured questionnaire that was administered to the medical professionals. The questionnaire was developed based on previous studies and was pretested before the main study to ensure its validity and reliability. A face to face interview was used to collect data from the respondents between August and September 2022.

Validity and Reliability of the Study

The validity and reliability of this study depend on several key factors which can be explained as follows:

Validity

1. Internal Validity: This refers to the extent to which the study accurately measures what it intends to measure. To certify internal validity, we employed appropriate research designs, data collection procedures, and statistical analyses. We carefully defined and operationalized the variables of interest, ensuring that the questions asked to assess knowledge, attitude, and practice of medical professionals regarding antibiotic resistance are clear and unbiased.
2. External Validity: This refers to the extent to that our findings can be generalized to other populations or settings beyond the three selected University Teaching Hospitals in Sierra Leone. To enhance external validity, the study applied a representative sample of medical professionals and considered factors that might affect the generalizability of their results, such as hospital size, location, and patient demographics.

Reliability

1. Internal Consistency: This aspect assesses the consistency of responses to the survey questions measuring knowledge, attitude, and practice among medical professionals. The researchers can use statistical measures like Cronbach's alpha to ensure that the survey items are internally consistent.
2. Test-Retest Reliability: This aspect examines the stability of responses over time. We conducted a pilot study with a small group of medical professionals and then re-administered the survey after a certain period to determine the test-retest reliability.

3. Inter-Rater Reliability: We were cognizance of the fact that multiple research assistants would be involved in data collection or coding. Hence, were able to come to agreement as to what should be done in common. This was ensured through training and standardization of data collection procedures.

To enhance both validity and reliability of the entire process, we carefully applied the following: we used a validated and standardized survey instruments to assess knowledge, attitude, and practice; we clearly defined the inclusion and exclusion criteria for selecting medical professionals, as stated above; we randomly selected participants to avoid sampling bias; used appropriate statistical analyses to interpret the data; conducted the study with an adequate sample size to ensure statistical power; and we addressed all potential confounder that may influence the results. The Cronbach's alpha is **0.856**, which indicates a high level of internal consistency for our research scale (Table 1).

Table 1. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.856	.864	9

Data Analysis

Descriptive Analysis

For the quantitative variables, descriptive statistics such as means, median and standard deviations were used to describe the study population; while for categorical variables, frequencies and percentages were recorded. The data were presented using figures and tables.

Statistical Analysis

Inferential statistics were used to test the associations between variables and to determine the factors associated with knowledge, attitude, and practice of medical professionals regarding antibiotic resistance. P-values <0.05 were considered statistically significant findings.

Use of SPSS for Data Entry, Codification, and Analysis

Data were entered and coded using Statistical Package for Social Sciences (SPSS) version 26.0. SPSS was also used for data analysis.

Ethical Considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics and Scientific Review Committee of Sierra Leone. Permission to conduct the study was obtained from the selected hospitals. Informed consent was obtained from each participant, and confidentiality of the data was ensured by using anonymous questionnaires and secure data storage.

Results

Sociodemographic Characteristics of Study Participants

In this study, a total of 376 participants were involved from three different university teaching hospitals. There were 46.8% (176) from ODCH, 30.9% (116) from PCMH and 22.3% (84) from Connaught (Figure 2).

Out of the total respondents, 73.7% (277) were females, whereas 26.3% (99) were males. Regarding participants' age groups, 39.4% (148) were between 25 – 35 years old. Looking at the educational attainment, 45.7% (172) participants had diplomas, followed by 33.8% (127) with certificates (Table 2).
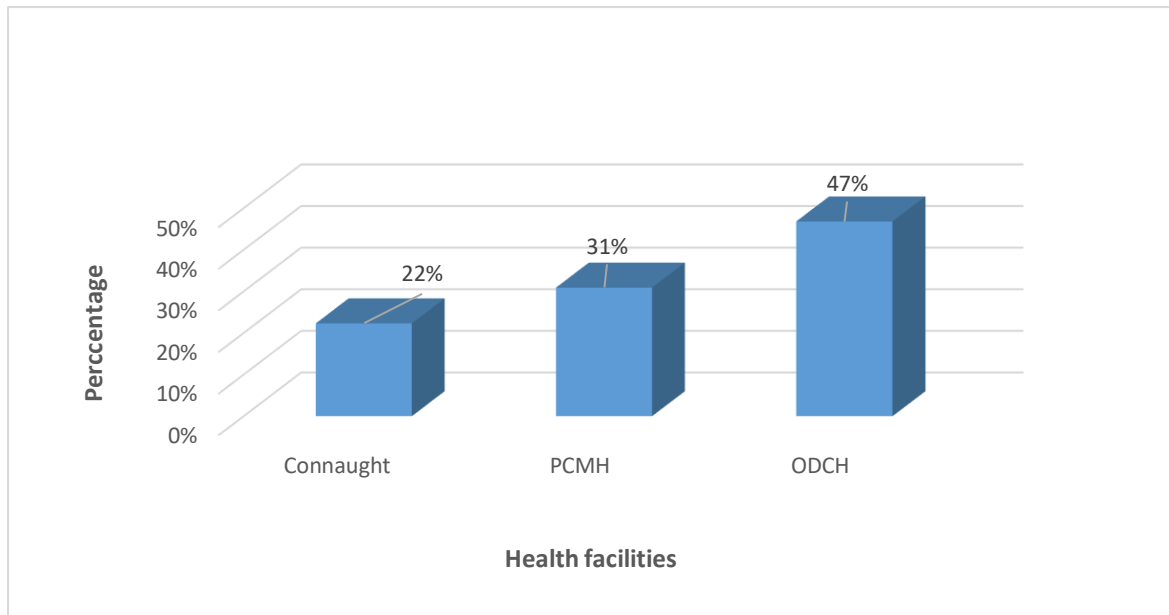
Figure 2. Distribution of Study Participants by University Teaching Hospital

Table 2. Qualification of Study Participants

Qualification	Frequency	Percent
Certificate	127	33.8
Diploma	172	45.7
Undergraduate Degree	68	18.1
Postgraduate Degree	9	2.4
Others	0	0
Total	**376**	**100**

Regarding the participants' profession, more than 2/3 (67.8%) were nurses vs (32.2%) who were all other profession categories (medical doctors, community health officers, pharmacists, pharmacy technicians, laboratory scientists, and others) (Table 3).

Table 3. Profession of Study Participants

Profession	Frequency	Percent
Nurse	255	67.81
Medical Doctor	39	10.37
Community Health Officer	26	6.91
Midwife	25	6.65
Pharmacy Technician	14	3.72
Laboratory Scientist	13	3.46
Pharmacist	3	0.81
Others	1	0.27
Total	**376**	**100**

On the account of years of experience, there was almost one-to-one for the three categories of years of experience: 33.78% (127) had less than 5 years, 33% (124) had 5 to 10 years and 33.22%

(125) had more than 10 years of experience. Looking at participants that had training on antibiotic resistance, more than half (51%) had training [51% (192) vs 49% (184)].

Knowledge of Antibiotic Resistance

These were the mean and standard deviation ($M = 58.9$, $SD = 18.12$) of study participants regarding their knowledge on antibiotic resistance.

Sixty-eight Percent (256) study participants with adequate knowledge of antibiotic resistance whilst 31.9% (120) had inadequate knowledge of antibiotic resistance (Figure 3).
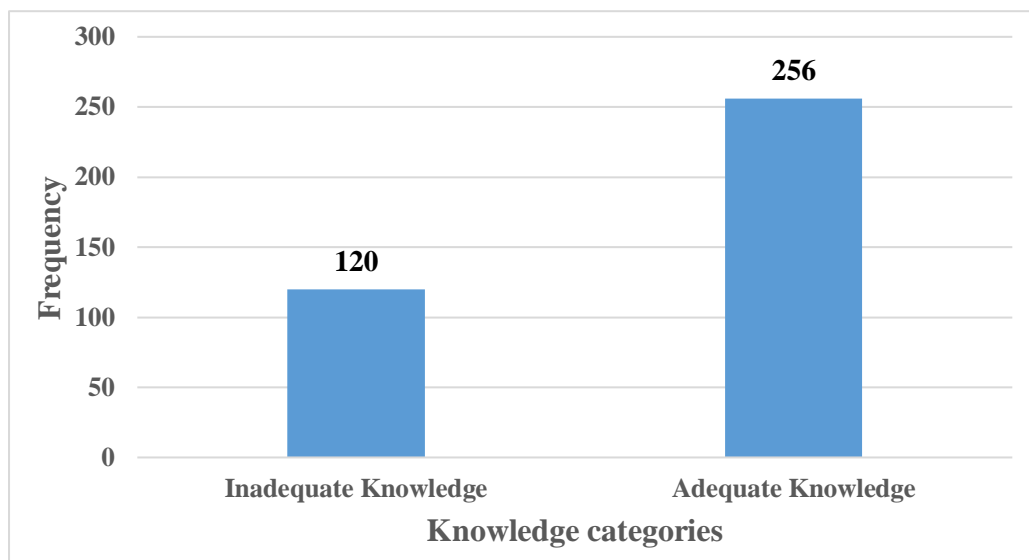

Figure 3. Distribution of Participants by Knowledge Categories

Accordingly, our results indicate that there was statistically significant association ($p < 0.05$) between knowledge and socio-demographic characteristics of health professionals (age, gender, profession, qualification and years of experience) and training on antibiotic resistance.

Attitude Towards Antibiotics

There were respectively 54% (203) and 72.9% (274) study participants who recommended that the pharmacy personnel should be at their workstation to deliver the services and on the other hand to dispense the antibiotics prescribed by the authorized prescribers as recommended by the Ministry of Health.

More than half (54.5%) of the study participants indicated that laboratory confirmed diagnoses is recommended before antibiotics administration. More than three-fourths (72.9%) of study participants recommended the completion of antibiotic courses to the patients to prevent antibiotic resistance.

Practice of Antibiotic Use

In line with rational prescription of antibiotics, 66.2% (249) study participants recommended the authorized prescribers to align on the standard treatment guidelines. In line with appropriate use of antibiotics by laypersons, more than three-forth (76.1%) study participants advised the Ministry of Health to regulate the sale of antibiotics. There were 62.8% (236) respondents who recommended the sessions of sensitization to the agricultural farmers on the practice of antibiotic use.

Discussion

The results of this study on AMR in Sierra Leone can be compared with previous studies conducted in Sierra Leone as well as studies from other parts of the world. By incorporating these comparative findings, we can gain a broader perspective on the AMR landscape in

Sierra Leone and its relation to global trends.

In terms of the proportion of institutions involved in AMR studies, the current study identified three university teaching hospitals in Sierra Leone that actively participated. This finding aligns with a study conducted by Lakoh and colleagues [13, 16] in Sierra Leone, which also reported the involvement of multiple healthcare institutions in AMR research. This consistency suggests a continued effort to address AMR through collaborative research initiatives within the country [1].

When examining the gender distribution of participants, the current study found that 73.7% of the participants were females, while 26.3% were males. This finding is consistent with a study conducted by [13] in Sierra Leone, which reported a similar gender distribution among AMR study participants. However, it is important to note that these proportions may vary across different studies and contexts. The higher percentage of females in the study might be partly due to the nurses (mostly females) in the medical profession. For example, a global study by [17] examining AMR in multiple countries found that gender distribution varied significantly, with some regions showing a higher proportion of male participants. This suggests that gender disparities in AMR research participation may differ based on cultural and contextual factors [11].

Comparing the findings from Sierra Leone with studies conducted in other parts of the world reveals both similarities and differences. For instance, a study by Tasneem and team [18] conducted in Vietnam reported the participation of multiple institutions similar to Sierra Leone. However, the gender distribution in the Vietnamese study showed a higher proportion of male participants compared to the findings in Sierra Leone. These variations emphasize the need to consider regional and country-specific factors when examining AMR and highlight the importance of context-specific interventions [19]. These comparative findings underscore the importance of region-specific approaches to

combat AMR and the need for further research to understand the unique challenges and dynamics of AMR in Sierra Leone.

Regarding training on antibiotic resistance, the study found that 51% of health professionals had received training on AMR, indicating a significant proportion of individuals with knowledge in this area, similar to this study [20]. However, it is worth noting that 49% of the participants had not attended any training on AMR, as seen in a similar study [21]. This finding highlights the need for increased training opportunities and awareness campaigns to ensure that a larger proportion of healthcare professionals in Sierra Leone are equipped with knowledge and skills related to AMR as stated in this study [22].

In terms of the participants' knowledge of antibiotic resistance, the study revealed that sixty eight percent (256) of the study participants had adequate knowledge in this area. This is an encouraging result as it indicates a majority of healthcare professionals in Sierra Leone possess the necessary understanding of antibiotic resistance. However, 31.9% (120) of the participants still lacked sufficient knowledge, suggesting the need for targeted educational interventions to bridge this knowledge gap and enhance AMR awareness among healthcare professionals. Based on these findings, it is evident that there is progress in terms of knowledge and training on AMR among healthcare professionals in Sierra Leone.

Based on the literature review and previous studies, the proportion of healthcare professionals with a positive attitude towards antibiotics can be evaluated. In the current study conducted in Sierra Leone, the results indicated that 72.9% (274) of the study participants recommended that pharmacy personnel should be available at their workstations to deliver services and dispense antibiotics prescribed by authorized prescribers, as recommended by the Ministry of Health. This finding suggests a favorable attitude towards ensuring appropriate access to antibiotics and adherence to

prescription guidelines.

Additionally, exploring the reasons behind attitudes towards antibiotics, such as through qualitative research or surveys, could provide deeper insights into healthcare professionals' perspectives and help inform targeted interventions and educational initiatives to promote appropriate antibiotic use.

Most of the participants were positive about creating a national system to monitor AMR, which could help reduce it. Just over half of respondents agreed to start such activities in their hospitals. More than half of healthcare professionals also agreed that educating prescribers about antimicrobial therapy is important in preventing AMR. This suggests that including AMR topics in the curriculum of healthcare professionals could be a significant step in reducing AMR, similar to what other studies have found [13, 14].

However, there is still room for improvement, particularly in increasing training opportunities and addressing the knowledge gaps observed. Future efforts should focus on developing comprehensive training programs, promoting continuous professional development, and implementing awareness campaigns to ensure a well-informed and prepared healthcare workforce in combating AMR in Sierra Leone.

Studying has several strengths. First, it used Structural Equation Modeling (SEM), which allowed the researchers to investigate various factors related to underlying variables. This approach is valuable for identifying gaps in knowledge and informing future interventions. Secondly, this study is among the few surveys conducted in sub-Saharan Africa that focus on antimicrobial resistance (AMR). This adds to the existing knowledge base and expands our understanding of AMR in this region. Overall, while the current study highlights a positive attitude towards antibiotics among a significant proportion of healthcare professionals in Sierra Leone, further research is needed to gain a more comprehensive understanding and identify potential areas for improvement in antibiotic

stewardship practices.

Despite the strengths and many issues discussed in this study, the study still has some limitations.

First, the study only discussed the findings from only three hospitals, thus the results cannot be generalized to all hospitals in Sierra Leone. Second, we did not verify or ascertain some of the claims made by the respondents regarding their attitudes and practices toward combating AMR. Third, data collection was only done during daytime. Healthcare workers who were constantly on the night shift were not included in the sample. Furthermore, data collected through surveys may be subject to self-reporting bias, where participants may provide socially desirable responses, affecting the accuracy of the findings.

Notwithstanding these shortcomings, the quantity and quality of evidence generated in this study can inform policies and interventions to address AMR in Sierra Leone.

Conclusion

This study has shown that there is a remarkable level of knowledge of antibiotic resistance among the healthcare professionals in the three selected university teaching hospitals in Sierra Leone.

One of the more significant findings to emerge from this study is that the pharmacy personnel should be available at their workstations to deliver services and dispense antibiotics prescribed. Compliance with the national system to monitor AMR was paramount among the healthcare professionals that could reduce AMR. Further studies are needed to gain a more comprehensive understanding and identify potential areas for improvement in antibiotic stewardship practices.

We recommend the University of Sierra Leone to encourage students to conduct further research across Sierra Leone to gain a deeper understanding of healthcare professionals' perspectives on antibiotics and the factors influencing their attitudes. Also, the Ministry of

Health in collaboration with the University of Sierra Leone to develop comprehensive training programs on antibiotic resistance for healthcare professionals to improve their knowledge and skills in this area.

Acknowledgment

Conflict of Interest

The authors declare no conflict of interest.

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