RESEARCH ARTICLE OPEN ACCESS

Assessing the Knowledge, Attitudes and Practices of Antibiotic Use and Antibiotic Resistance in Sierra Leone- A case study of patients and prescribers at the Kenema Government Regional Referral Hospital of the East

by:

Authors: Rashid Bundu Kpaka (Department of Nursing, Faculty of Health Sciences and Disaster Management Studies, Eastern Technical University of Sierra Leone)**;** Professor Yangmu Huang (Department of Global Health, School of Public Health, Peking University Health Science Center, Beijing china) and Dr. Donald Samuel Grant (District Medical Officer, Kenema District Health Management Team, MoHS-SL)

ABSTRACT

Antibiotics resistance (ABR) is a rapidly growing problem worldwide and a major global public health security threat to nations and multiple sectors and have negatively influence healthcare, veterinary, and agriculture and therefore require effective and immediate multi-lateral and multi-sectorial actions to curb its spread. Antibiotic resistance can occur naturally; however, misuse of antibiotics in humans and animals, inadequate IPC programs, poor-quality medicines, insufficient laboratory capacity, inappropriate food handling, poor surveillance and lack of regulations to ensure appropriate use of anti-microbial drugs accelerates the process. This particular research aims to determine the knowledge, attitude, and practice of antibiotics use and resistance among patients and prescribers at the Kenema Government referral hospital of the east, Sierra Leone.

A quantitative cross-sectional Knowledge Attitude and Practice (KAP) survey using a five points likert scale separate questionnaires for both patients' and prescribers' participants; anon-probability sampling design using a convenience sampling for patients and a systematic random sampling method for the prescriber participants were used to evaluate the knowledge, attitudes and practice of antibiotic use and resistance. Data were imputed into excel 2016 and analyzed using Microsoft Excel toolpak for statistical analysis; descriptive statistics was used for all variables and results were presented in frequencies and percent distribution tables.Correlation/association between knowledge, attitudes and practices of the patient's and prescribers' respondents were evaluated using multiple linear regression and simple linear regression respectively at an accepted statistical significance of $p<0.05$. . The result found out that patients' knowledge and attitudes significantly predicted their practices/behavior {(β = [0.648], p = [0.016]) and (β = [-0.789], p = [0.031])} respectively.The results further showed that patients' Antibiotics use knowledge scores (β = [0.648], p = [0.016]) and Antibiotics use attitude scores (β = [-0.789], p = [0.031]) together had a better influence on the increase in Antibiotics use practice scores (β=103.011; p = 0.029) than their independent effect.The results of linear regression analysis of the association between knowledge scores showed that each unit increase in ABR knowledge score of prescribers was associated with 0.847 increases in the antibiotics prescription behavior scores (β= 0.847; p = 0.044).

The main finding of this study is that there are statistically significant associations between knowledge scores and certain destructive and protective antibiotics use amongst patients and prescribers. Therefore if knowledge levels are improved on, it could be possible to influence these behaviors and designing effective and efficient approaches to effect a positive change among the public towards rational use of antibiotics is very key.

INTRODUCTION

Resistance is a result of mutations in microbial organisms, gene transfer and selection pressure from use of antimicrobial medicine that gives the mutated strains a competitive advantage [6]. Antimicrobial resistance (AMR) is a rapidly growing problem worldwide [1-3]. **Antimicrobial resistance (AMR), or drug resistance**, develops when microbes (SUPERBURGS), including bacteria, fungi, parasites, and viruses, no longer respond to a drug that previously treated them effectively.AMR describes the opposition of any pathogen to medications meant to destroy them.

Antibiotics are medications used for the management and prevention of bacterial infections. "**Antibiotic resistance (ABR)** is the ability of bacteria (SUPERBURGS), to resist the effects of an antibiotic" [4]. The "resistant" bacteria continue to multiply in the presence of an effective dose of an antibiotic [5]. This means that bacteria that are responsible for the causation of common infections, currently easy to treat illnesses are becoming resistant to treatment regimen and as a result infections and mortality rate may increase. Antimicrobial resistance is a major global public health security threat to nations and multiple sectors and have negatively influence healthcare, veterinary, and agriculture globally and therefore require effective and immediate multi-lateral and multi-sectoral actions to curb its spread. Antibiotic resistance can occur naturally; however, misuse of antibiotics in humans and animals, inadequate IPC programs, poor-quality medicines, insufficient laboratory capacity, inappropriate food handling, poor surveillance and lack of regulations to ensure appropriate use of anti-microbial drugs accelerates the process [7, 8, 3,4]. Antibiotics have been widely misused by humans which have increased the selection and spread of resistant bacteria. [35] Animal husbandry is also a major sector that uses antibiotics as growth promoters to animal feed which has an unquantifiable impact on resistance levels; this use needs to be minimised and monitored so as to reduce impacts on ABR [25].In order to slow down ABR, antibiotics should be prescribed and used only when absolutely necessary [26] and the efficacy of existing antibiotics should be preserved through measures to minimize the development and spread of ABR [28,29].

Antibiotics are among the most common medicines consumed in low- and middle-income countries (LMICs) [21] in both community and healthcare settings [15] and the rates of use are typically higher in hospitalized patients [16, 18, 34]. The economic and technological advancement of most LMICs nations have increased ease accessibility to antibiotics which in turn has led to indiscriminate prescription habit of prescribers and this has added to the escalating trends of ABR [22]. ABR can greatly negatively affect health care such as long term hospitalization due to treatment failure, increase in death rate, increase healthcare costs due to severe infection episodes, and other adverse effects [12]. Other factors that accelerate misuse of antibiotics in LMICs include; poverty, poor patient and provider education, lack of local or international functional regulatory systems and inadequate laboratory facilities [10, 20].
According to CDC report, in USA alone on a yearly basis, about 2 million of the US population gets infected with resistant bacteria and 23, 000 die as a direct consequence of ABR [**Error! Reference source not found.**]. O'Neill and others' modeling project report on the assessment of the impact of resistance revealed that if the world fails to reduce the growing trends of resistance through urgent and effective prevention intervention strategies by 2050 the cost of ABR will reach up to 100 trillion USD and about 10 million deaths will occur each year due to resistance and the Asians (4,730, 000) and Africans (4,150, 000) will die the more [27].

Due to inadequate surveillance activities on the magnitude and impact of ABR in most African countries, much is not known about this problem in this continent, [28] although the problem is so grave that it was a subject of discussion at the United Nations General Assembly meeting in September 2016, the 4th time in the history that a health topic has been the focus of such an assembly and this is why the WHO have even

considered it as a top ranking global public health security threat that needs global intervention [14]. Two similar but separate independents systematic studies and meta-analysis done in Ethiopia and china among the general public on antibiotic usage and resistance problem reveals inadequate knowledge and misuse and abuse of antibiotics as a serious problem [44, 34].

Multiple studies around the globe have been conducted in assessing clinicians' knowledge, attitudes and practices of resistance. One example of such famous study was undertaken by McCullough and colleagues which pointed out great ABR knowledge among prescribers and recognized it as an important public health issue although quite a large number blamed patients for the development of ABR due to their non-adherence and over consumption of antibiotics [**Error! Bookmark not defined.**]. An Australian study revealed great misunderstanding among prescribers with regards the actual etiologies of resistance and about 40% of prescriber respondents agreed to have prescribed antibiotics only to satisfy their clients [**Error! Bookmark not defined.**]. An India research found more than 65% wronged medication order by clinicians and mostly were inappropriate and over prescriptions resulting from lack of knowledge about recent treatment regimen due to non-availability of both local and international standardized treatment protocols [**Error! Bookmark not defined.**].

Sierra Leone is among nations that have reported resistance strains and just like many other LMICs, there is not much information on the rate and pattern of antibiotic use in sierra Leonean hospitals, there is less or no restriction on over the counter access to antibiotics therefore, majority of patients and relatives purchase their drugs from pharmacies and drug stores outside the hospitals and also on the part of the prescribers there is inadequate diagnostic laboratory support to guide their antibiotic prescription, all these accelerate an indiscriminate use among the general public and perhaps have contributed to this widespread of resistance which has negatively affected the environment and health care delivery systems.Abuse of antibiotics in Sierra Leone is usually caused interaction between so many factors and involves multiple sector, such as patients' knowledge, beliefs, and attitudes towards antibiotic use, self-medication, patients' expectations, and patients' experience with antibiotics, prescribers' expertise, diagnostic uncertainty, perceptions of patients about the patient-prescriber interaction, and insufficient patient education by prescribers. Therefore the role of pharmacists/drug stores, health workers and patients in reducing ABR threat is highly recognised and cannot be over emphasized. A cross sectional analysis on Antibiotic use among hospitalized adult patients in SL 2018 have also recorded wrong medication order, OTC antibiotics access, polypharmacy, misleading advertisements and indiscriminate antibiotics use as key challenges [39]. Therefore, to ensure rational and appropriate utilization of antibiotics in SL needs multi-sectorial collaboration of knowledgeable public mobilized societies and engaging health works.

World Health Assembly had endorsed a global action plan on AMR/ABR in May 2015. Raising public awareness and improving understanding of AMR are the key strategic objectives of this comprehensive plan on AMR. WHO have suggested the monitoring and educational interventions aimed at rationalizing the antibiotics prescription, disposal, and consumption to curb ABR. Antibiotic development was a major breakthrough in defeating infections; however, their vast use has led to antibiotics resistance (ABR) causing mortality, morbidity, and economic loss worldwide. Antimicrobial stewardship programmes (ASPs) with the mainstay of awareness raising can be an ideal strategy to curb ABR. ABR is not something that can be stopped, but it can be slowed down by understanding both patients' and prescribes' knowledge, attitudes and practice of antibiotic use and resistance, and tailoring interventions around these. If resistance interventions are going to be successful, an understanding of current knowledge, attitudes and practice of a broader range of patients need to be understood in a quantitative manner.

In Sierra Leone over the counter availability of most potent antibacterial drugs, irresponsible use by patients and indiscriminate prescription habits by clinicians makes the problem a tri-faceted one involving patients,

pharmacy or drug store owners, and prescribers. So far, there has not been even a single study assessing patients and prescribes knowledge and attitudes towards ABR in the eastern region of Sierra Leone. This study aims to investigating the knowledge, attitude and practice of antibiotic use and resistance among adult patients and prescribers at the Kenema Government regional referral Hospital of the East, Sierra Leone.

This Researchtherefore will be able to provide answers to the following questions:

I) What is the current state of knowledge level, attitudes and practices of patients about antibiotics use and issues of resistance at the Kenema Government Hospital?

II) Do prescribers at the KGH have an up to date general knowledge and standard antibiotics prescription behavior in relation to ABR?

III) Does prescribers' and patients' level of knowledge influence their behavior (attitudes and practice) towards antibiotics use and ABR?

RESEARCH METHODOLOGY

Study Design

A quantitative cross sectional KAP study using five point likert scale separate questionnaires for both patients' and prescribers' participants to evaluate the knowledge, attitudes and practice of antibiotic use and resistance at the KGH. A non-probability sampling design using a convenience sampling approach was used to select patient's research subjects and a systematic random sampling method was employed to choose prescribers' respondents. These survey techniques were used because of their relatively time saving and cost effectiveness at the same time suitability for the nature of the research as compared to other survey techniques. The convenience sampling was used for the patients group because it was helpful in obtaining a range of attitudes and opinions from participants wherever and whenever was convenient as it is difficult getting them always at one place in a given period especially the out patients'. Like the systematic sampling method used for the prescribers, there was opportunity for organized even distribution of members to form a sample with a very minimal risk of selection bias.

Study Location

The location (study site) for this research is the Kenema Government Hospital (KGH). The KGH is in Kenema City situated at the east end of the City along Combema Road and Sumaila Street junction and very closed to the Eastern Technical University SL, Kenema. It was established in 1958. The hospital serves as the regional referral hospital for the eastern region and as the district referral Hospital for Kenema District serving a population of 169,937 people according to the SL 2015 housing and population census. It carries out both medical and surgical treatment as well as maternal and child health services, dental, ophthalmic, TB, under-fives and laboratory services amongst others. It also double serves as a teaching hospital for nurses and other allied health professionals.

Study Population

This study targeted the total number of prescribers (clinicians) at the KGH, estimated as 750 [**Error! Reference source not found.**] and registered patients visiting the Kenema Government Hospital for health care services during the months of August 1st and September 30th , 2021 and according to the out patient records, the total registered patients for this period was approximately 1040 [**Error! Reference source not found.**]. The inclusion criteria for patients included all the patients who registered for health consultations at the facility during the data collection period (August 1st –September 30th, 2021) and those patients who manifested interest in the research. Patients under the ages of 15 years and those who registered before and after the said period were

excluded. For the prescribers the inclusion criteria were clinicians (prescribers) who were working, stationed and showed up at the time of the data collections and manifested interest in the research.

Sample Size Estimation Technique

The calculation for the sample size of this study was done using an online Raosoft sample size calculator software [Error! Bookmark not defined.] and wallstreetmojo sample size formula [Error! Bookmark not defined.] with 95% CI. Since there was no empirical evidence based on previous research on the topic for the KGH/Kenema community and likely other areas within the country, a 50% expected response will be selected to get the sample proportion with a 5% margin of error. The calculation resulted in the sample size of 281 patients and 254 prescribers from the total study populations.

$$\text{Sample size, } n = N * \frac{\frac{Z^2 * p * (1-p)}{e^2}}{[N - 1 + \frac{Z^2 * p * (1-p)}{e^2}]}$$

Where,

- N = Population size= 1040 for patients and 750 for prescribers
- Z = Critical value of the normal distribution at the required confidence level=95% (1.96)
- p = Sample proportion/expected response= 50% (0.5)
- e = Margin of error

Sample Size n = N × {[Z^2 × p × (1-p)/e^2] / [N – 1 + Z^2 × p × (1-p)/e^2]}

n= 1040 × {[1.96 ^{2}) × 0.5× (1-0.5)/ (0.05 ^{2}]/ [1040 – 1+ (1.96 ^{2}) 0.5× (1-0.5)/ 0.05 ^{2}]} =**281** for patients

n= 750 × {[1.96 ^{2}) × 0.5× (1-0.5)/ (0.05 ^{2}]/ [750 – 1+ (1.96 ^{2}) × 0.5× (1-0.5)/ 0.05 ^{2}]} =**254** for prescribers.

Research Instrument

A well-structured self-administered separate set of questionnaires for patients and prescribers were used to collect research data. In order to identify potential questions for the patient questionnaire,similar studies that have been conducted were reviewed[31,42].The updated patient questionnaire for this study was then well adapted to local context and consisted of section of social demographic characteristics and 31 questions covering three major areas: i) 17 questions on knowledge about ABR, ii) 7 about attitude and iii) 7 practice questions on antibiotic usage and disposal. See Annex B&C for the sample questionnaires.

Just like the patients, a well-organized and structured self-administered questionnaire was also designed for the prescribers. The questionnaire was developed after an extensive literature review on similar studies [492, 49, 492] and was adapted based on the research objectives and recommendations of the supervisor, co supervisor and some experts in the field. Final questionnaire for prescribers consisted of sections of social demographic characteristics, and 17 specific 5 points likert questions covering questions about general knowledge of antibiotics and resistance and prescription behaviors in the context of ABR.

Data Collection Method

A non-probability sampling design using a convenience sampling approach was used to select patient's research subjects. Individual Patients' participants were politely approached with greetings followed by introduction of data collectors and clearly stating the purpose of the research. Consent was obtained in written and or verbal manner by researcher and / team (including some reception staff at General Practitioner (GP) offices or stations), after which they were asked to complete the questionnaire. Instructions and guidance on how to complete the questionnaire were given to each participant. Participants who were able to read and write English Language were offered the questionnaire to complete it and for those participants who were not

English Language literate, the questionnaires were translated to them in creole (the common language) in an orderly manner there after their responses were filled accordingly in the questionnaire. Each participant was appreciated with kind words of a thank you.

On the other hand a systematic random sampling method was employed to select the prescribers' participants. Selected subjects were approached with usual greetings and introduction of research team, purpose was established and consent was sort appropriately and a copy of the prescriber questionnaire was offered to be filled accordingly and was later collected.

Data Reliability and Scoring

The Cronbach's α test was used to assess the data reliability of this study [40]. The questionnaires were pre-tested and validated on 25 nursing students, 15 for patients and 10 for prescribers. The patient questionnaire was divided into 3 sections (knowledge, attitude and practice), and the test results were 0.701, 0.934 and 0.575 respectively and the prescriber's result for knowledge and antibiotics prescription behavior was found to be 0.889 and 0.799 respectively. The results of the Cronbach's α test showed that the instrument possessed good internal consistency and reliability except for the knowledge section of the patient's data set which shows some amount of inconsistencies.

Responses were scored against a five-point Likert-scale ("Strongly disagree" to "Strongly agree"), "strongly agree" or "agree" were classified as agreed and "strongly disagree" or "disagree or Don't know" as disagreed for the knowledge section and "strongly agree" or "agree" were classified as agreed and "strongly disagree" or "disagree as disagreed or Don't know" as average for the attitudes and practices section for both questionnaires. The knowledge, attitude and practice scores for patients were calculated by adding the number of correct answers and also mean and SD were determined. Participants were divided into two categories on the basis of the level of knowledge they possess. Those who responded as "strongly agree" or "agree" to POSITIVE (TRUE) statements and "strongly disagree" or "disagree to NEGATIVE (FALSE) statements were categorized into HIGH knowledge possessing group. Similarly, those whose responses were "strongly disagree" or "disagree or don't know" to POSITIVE (TRUE) statements and "strongly agree" or "agree" to NEGATIVE (FALSE) statements were categorized into LOW knowledge possessing group.

On the other hand, attitude and practices scores were categorized into three levels denoted by GOOD (if a participant "strongly agreed" or "agreed" with a POSITIVE (TRUE) statement or "strongly disagreed" or "disagreed with a NEGATIVE (FALSE) statement) and vice-versa for the BAD level, the mean and SD were also considered. All responses with "Don't know" were placed in the AVERAGE attitude and practice levels; a similar scoring system has been used in previous research done in district Sialkot, Pakistan [492].

Statistical Analysis

All the completely filled questionnaire's data were imputed into excel 2016 and analyzed using Microsoft Excel toolpak for statistical analysis and descriptive statistics was used for all variables and results were presented in frequencies and percent distribution tables.Based on study objectives, the patients' data analysis was divided into the following parts; i.e. questions to assessing knowledge (awareness), questions to determine attitudes (beliefs), and practices (behavior) and exploring associations between the knowledge, attitudes and practice of patients about antibiotic use and resistance. Knowledge scores of patient respondents were divided into HIGH and LOW levels and association between socio-demographic characteristics (gender, age, education, income etc.) were tested for significance using binary logistics regression. Similarly attitudes

and practices scores were divided into bad, average and good categories and association between the patients' demographic variables were tested for significance multivariable logic analysis.

Equally, general knowledge and prescribing behaviors of prescribers were described based on their responses to individual questions in the questionnaire. Knowledge scores of prescribers was divided into high and low levels and antibiotics prescribing behaviors were divided into bad, average and good categories. Patient expectations were also assessed through the prescriber answers. Proportions were calculated and results were summarized by frequencies and percent distribution for all variables. Questions regarding the antibiotics disposal and/or return were included in both questionnaires to explore the knowledge regarding environmental route of ABR spread.

Correlation/association between knowledge, attitudes and practices of the patient's and prescribers' respondents were evaluated using multiple linear regression and simple linear regression respectively at an accepted statistical significance of $p<0.05$.

Conceptual Frame Work

It is hypothesized that poor knowledge (awareness) about antibiotics resistance, bad attitudes (beliefs or opinions/personal feelings) and practices (behavior/ exhibited actions) towards antibiotics use give rise to destructive antibiotics usage (abuse and misuse), consequently resulting to high levels of ABR; this is demonstrated as thus;

Patients/Prescribers →Poor knowledge→ Bad Attitudes → Bad Practices→ Destructive Antibiotic use (misuse) → Accelerated ABR levels

To curb the problems of resistance requires a thorough quantitative understanding of patients and prescribers' current knowledge, attitudes and practices; it is against this clue that this project was designed to investigation the KAP of Antibiotic use and issues of ABR so that the problem can be understood at local level.

Ethical Consideration

An approval from the Sierra Leone Ethics and Scientific Review Committee was obtained and approval granted prior the start of the project, see appendix D. The researcher also seeks the consent of the hospital management ethical committee to gain access to the research participants and available data in the facility. The student researcher also promise that information obtained remains confidential, only use for academic purpose and shared only with authorized personnel of importance.

Informed Consent was obtained from each respondent before they were included in the research. Participants in this study were treated fairly and equitably. Only identification numbers were allocated to respondents, all other personal details were not recorded. All research data were classified and respondents Privacy and confidentiality were highly respected in the entire process. All electronics collated data are paper survey data are also highly secured.

Results

Socio-demographic information of Patient's Participants

Table 3.1 below shows the socio-demographic characteristics of the participants. 281 patient's participants took part in the survey of which majority 54.0% (n = 151) were females, 44.0% (n = 124) were graduates from tertiary institutions and 48.0% (n = 134) were students. About 81.54% belongs to the age brackets of 15-30 representing 40.9% (n=115) and 43.8% (n=123) of the participants earn about >2,000,000 per month.

Approximately 52.0% were the working group. 90% (n = 253) of the participants admitted they knew about ABR and 24%, 22% claimed they knew about ABR through social media and health workers respectively.

Table 3.1 Socio-Demographic Characteristics of patient's respondents at KGH

Variables	Categories	Frequencies (%)
Gender	• Male	130 (46%)
	• Female	151 (54%)
Age bracket	• 15-30	115 (40.9%)
	• 31-45	106 (37.7%)
	• >45	60 (21.4%)
Occupation	• Business	51 (18%)
	• G. Employee	60 (21%)
	• Student	134 (48%)
	• Other	36 (13%)
Educational level	• No Schooling	27 (10%)
	• P. Education	35 (12%)
	• High School	95 (34%)
	• University	124 (44%)
Monthly income in Leones	• ≤500,000	86 (30.6%)
	• 1,000,000-1,999,000	72 (25.6%)
	• >2,000,000	123 (43.8%)
I know about antibiotics resistance through	• Health worker	63 (22%)
	• Social media	67 (24%)
	• Friends	61 (22%)
	• Print/E Media	58 (21%)
	• Don't Know	32 (11%)

Patient's participants Knowledge about antibiotics and antibiotic resistance

Table 3.2 shows the respondents' knowledge on antibiotics and antibiotic resistance.

A total of 47.4% (n = 133) of the patients under study were possessing low knowledge about ABR as compared to 52.6% (n = 148) of patients who were placed into high knowledge possessing category. These values are indicative of when approximately forty percent (40%) of participants agreed with the statement "Flu and Common Cold can be cured with a course of antibiotics". About 45.6% of the respondents thought that antibiotics are effective against bacteria, as compared to 60.2% who thought that antibiotics are effective against viruses. majority of respondents (73.3%) knew that Antimicrobial resistance is the tolerance level of the body after which our body gets used to the antibiotic. Also, a much higher proportion (69.4%) disagreed that Antimicrobial resistance develops when antibiotics no longer work to treat infection. Only about one third (33.3%) of the respondents thought that antibiotic resistance is a problem in their country, and a bit higher proportion (37%) thought that it is a problem in the rest of the world today. About 26% of participants strongly agreed that Antibiotics will work less well in future if overuse them now, about 80%believed Antibiotic resistance is likely to be very costly to the world and 18.9% thinks scientists will discover new antibiotics if the current ones stop working.

Table 3.2 ABR related knowledge Based Questions of respondent patients in KGH

No.	Statements	Strongly disagree- n (%)	Disagree-n (%)	Neutral- n (%)	Agree- n (%)	Strongly agree n (%)
1	Antimicrobial resistance develops when antibiotics no longer work to treat infection	165 (58.7)	30 (10.7)	10 (3.6)	8 (2.8)	68 (24.2)

2	Antimicrobial resistance is a global problem.	**2 (0.7)**	**172 (61.2)**	**3 (1.1)**	**40 (14.2)**	**64 (22.8)**
3	AMR/ Super bugs can be a cause of death.	104 (37.0)	69 (24.6)	6 (2.1)	35 (12.5)	68 (24.2)
4	People can be allergic to antibiotics.	2 (0.7)	174 (61.9)	4 (1.4)	71 (25.3)	30 (10.6)
5	Our body has 'good' bacteria which keeps us healthy.	2 (0.7)	113 (40.2)	0 (0)	71 (25.3)	95 (33.8)
6	Antibiotics are good for treating germs called bacteria.	105 (37.4)	0 (0)	48 (17.1)	0 (0)	128 (45.6)
7	Antibiotics can be harmful by killing the 'good' bacteria	13 (4.6)	40 (14.2)	20 (7.1)	135 (48.0)	73 (26.0)
8	Antimicrobial resistance is the tolerance level of the body after which our body gets used to the	65 (23.1)	8 (2.8)	2 (0.7)	167 (59.4)	39 (13.9)

antibiotic.

Continued Table 3.2 ABR related knowledge Based Questions of respondent patients in KGH

No.	Statements	Strongly disagree- n (%)	Disagree-n (%)	Neutral- n (%)	Agree- n (%)	Strongly agree n (%)
9	Flu and Common Cold can be cured with a course of antibiotics.	64 (22.8)	105 (37.4)	0 (0)	79 (28.1)	33 (11.7)
10	MRSA is a type of cancer.	75 (26.7)	47 (16.7)	0 (0)	88 (31.3)	71 (25.3)
11	Antibiotics are an effective therapy against viruses.	65 (23.1)	47 (16.7)	0 (0)	128 (45.6)	41 (14.6)
12	Antibiotics can cause diarrhoea in healthy people	2 (0.7)	140 (49.8)	0 (0)	100 (35.6)	39 (13.9)
13	All people with a sore throat need antibiotics.	33 (11.7)	71 (25.3)	0 (0)	177 (63.0)	0 (0)
14	Antibiotics only kill the 'bad' bacteria that make you sick.	50 (17.8)	138 (49.1)	0 (0)	93 (33.1)	0 (0)
15	Antibiotics will work less well in future if we overuse them now.	0 (0)	53 (18.9)	0 (0)	2 (0.7)	226 (80.4)
16	Antibiotic resistance is likely to be very costly to the world.	0 (0)	53 (18.9)	0 (0)	2 (0.7)	226 (80.4)
17	Scientists will discover new antibiotics if the current ones stop working.	0 (0)	228 (81.1)	0 (0)	53 (18.9)	0 (0)

Unadjusted analysis of patient's knowledge scores and demographic characteristics

Association between patient knowledge and socio-demographic features were determined using binary logistic regression at the chosen level of 0.05. About 20 (7.1%) patients answered all the questions correctly, 6

(2.1%) patients responded incorrectly to all the questions and the mean knowledge score was 13 (out of a maximum of 17, SD 3) with OR of 0.97 (.92 - 1.03) . Significant statistical associations were found between the gender and level of education of patients and mean knowledge scores. An association was found between gender with OR of 1.29 (95% CI: 1.18-1.44). Patients with higher educational level had 0.44 times lower odds of AMR knowledge compared to those with lower educational level (OR= 0.44; 95% CI: 0.26-0.73) whose highest qualification was below high school.

Table 3.2.1 Association of patient's knowledge scores and demographic characteristics

Demographic variables	Characteristics variables	N (%)	Unadjusted OR (95%CI).	*Unadjusted p* value
Knowledge scores	Low	133 (47.4%)		
	High	148 (52.6%)	0.97 (.92 - 1.03)	0.373
Gender	Male/female	281 (100%)	1.29 (1.18-1.44)	0.001
Age	Below 35 years	115 (40.9%)	0.99 (0.98-1.00)	0.213
	Above 35 years	166 (59.1%)		
Education level	Below high school	62 (22%)	0.65 (0.36-1.19	0.161
				0.002
	Above high school	219 (78%)	0.44 (0.26-0.73)	
Monthly income (Le)	Below 1,999,000	158 (56.2%)	2.33 (0.82-6.60)	0.112
				0.063
	Above 2,000,000	123 (43.8%)	3.04 (0.94-9.82)	

Patient's participants Attitude towards antibiotic use

Table 3.3 shows the participants' attitudes towards antibiotics and antibiotic resistance.

The distribution of patient respondents according to the "good", "average" and "bad" attitude was found to be 55.2% (n=155),11.3% (n=32) and 33.5% (n=94), respectively. This was seen when majority of respondents (63.3%) do not believed that it is good to be able to buy antibiotics over the-counter at the pharmacy without seeing a doctor, over 80% responded they do not know when to use antibiotics and therefore needs prescriptions from a doctor and 63.7% disagreed with the statement "I do not complete the course of my antibiotics treatmentbut stop when i feel better after a few days. Nearly half (50.1%) disagreed of not have insisted for antibiotic prescription to the doctor. Large number of the participants (76.5%) disagreed with the statement "I prefer to keep antibiotics at home in case there may be a need for them later". Over half of the respondents (58.7%) disagreed with the statement "It is good to be able to get antibiotics from relatives or friends without having to see a doctor" and many of the respondents strongly agreed (63.3%) with the statement "The use of antibiotics when you are sick in order to remain active when you have a cough for more than a week is appropriate"

Table 3.3 ABR related Attitude Based Questions of respondent patients in KGH.

No.	Statements	Strongly disagree- n (%)	Disagree- n (%)	Neutral- n (%)	Agree- n (%)	Strongly agree- n (%)
1	I feel I know when to use antibiotics (for at least diarrhea etc.). I don't need prescriptions.	26 (9.3)	204 (72.6)	55 (19.6)	0 (0)	0 (0)
2	I have insisted for antibiotic prescription to the doctor (even once)?	36 (12.8)	0 (0)	102 (36.3)	142 (50.5)	1 (0.4)
3	If I feel better after a few days, I sometimes stop taking my antibiotics before completing the course of treatment.	42 (14.9)	137 (48.8)	0 (0)	86 (30.6)	16 (5.7)
4	I prefer to keep antibiotics at home in case there may be a need for them later	0 (0)	215 (76.5)	0 (0)	66 (23.5)	0 (0)
5	It is good to be able to get antibiotics from relatives or friends without having to see a medical doctor.	0 (0)	165 (58.7)	65 (23.13)	51 (18.1)	0 (0)
6	I prefer to buy antibiotics from the pharmacy without a prescription.	178 (63.3)	0 (0)	0 (0)	103 (36.7)	0 (0)
7	I prefer to use an antibiotic if I have a cough for more than a week.	0 (0)	102 (36.3)	1 (0.4)	0 (0)	178 (63.3)

Unadjusted analysis of patient's attitude scores and demographic characteristics

Association between patient attitude and socio-demographic features were determined using multivariable logistic regression at the chosen level of 0.05. All the questions were correctly responded to by 18 (6.4%) patients and 4 (1.4%) patients responded incorrectly to all the questions with a mean attitude score of 11 (out of a maximum of 7 questions, SD 3). The analysis showed that the attitude score was significantly associated with the gender, level of education and monthly income of patients. In adjusted analysis, positive attitude towards antibiotic use was associated with the antibiotic misuse with the OR of 1.16 (95% CI: 1.03-1.29). Attitude towards antibiotic use was associated with patients' gender with the OR of 1.21 (95% CI: 1.04-1.42). The respondents with higher educational level above high school had 0.46 times lower odds of misuse compared to those with lower educational level (OR= 0.46; 95% CI: 0.24-0.85). The significant association between antibiotic use attitudes and monthly income level higher than Le 2,000,000 was observed with the OR of 3.97 (95% CI: 1.15-13.75). (Table 3.3.1).

Table 3.3.1Association of patient's attitude scores and demographic characteristics

Demographic variables	Characteristics variables	N (%)	Unadjusted OR (95%CI).	*Unadjusted p* value
Attitude scores	Bad	94 (33.5%)		
	Average	32 (11.3%)	1.16 (1.03-1.29)	0.014
	Good	155 (55.2%)		
Gender				
	Male/female	281 (100%)	1.21 (1.04-1.42)	0.017

Age	Below 35 years	115 (40.9%)	0.98(0.67-1.45)	0.935
	Above 35 years	166 (59.1%)		
Education level	Below high school	62 (22%)	0.76 (0.37- 1.56)	0.451
	Above high school	219 (78%)	0.46(0.24-0.85)	0.015
Monthly income (Le)	Below 1,999,000	158 (56.2%)	2.60(0.88- 7.70)	0.084
	Above 2,000,000	123 (43.8%)	3.97(1.15-13.75)	0.031

3.4 Patient's participant's Antibiotic use practices (behaviors)

The distribution of patient respondents according to the "good", "average" and "bad" practices was found to be59.4% (n=167), 4.9% (n=14) and 35.7% (n=100) respectively. This was seen when majority of the respondents (69.4%) agreed that they have consumed antibiotics without a doctor's prescription. About 80.4% of the respondents have ever used antibiotics not because they are sick/ how sick they are, but what kind of illness they have. Out of 281 participants 81% strongly agreed with the statement "Antibiotics are strong and I only take them when I really need them, and 22.8% do not always finish the course of their antibiotics regimen knowingly or unknowingly, they stop when they feel better. However, a small proportion (23.8%) agreed of using antibiotics when they have a sore throat and more than half (60%) of the respondents have agreed on disposing of the antibiotics with household waste. Approximately all of the respondents (90%) reported using antibiotics when they have tried simple remedies but did not work.(Table 3.4).

Table 3.4 ABR related Practice Based Questionsof respondent patients in KGH

No.	Statements	Strongly disagree- n (%)	Disagree-n (%)	Neutral- n (%)	Agree- n (%)	Strongly agree- n (%)
1	I have taken antibiotics not because am sick/ how sick I am, but what kind of illness I have.	0 (0)	55 (19.6)	0 (0)	0 (0)	226 (80.4)
2	I have taken antibiotics when I have tried simple remedies but they did not work	0 (0)	29 (10.3)	0 (0)	26 (9.3)	226 (80.4)
3	Antibiotics are strong and I only take them when I really need them	53 (18.9)	0 (0)	0 (0)	2 (0.7)	226 (80.4)
4	I have consumed antibiotics without a doctor's prescription (ever)?	9 (3.2)	11 (3.9)	66 (23.5)	92 (32.7)	103 (36.7)
5	When I have a sore throat I prefer to use an antibiotic	36 (12.8)	178 (63.3)	0	67 (23.8)	0 (0)
6	I often dispose of my antibiotics along with the household waste.	0 (0)	112 (39.9)	0 (0)	103 (36.7)	66 (23.5)
7	I always complete the course of	12	21	31	153	64

treatment with antibiotics even if I feel better.	(4.3)	(7.5)	(11.0)	(54.4)	(22.8)

Association of patient's practice scores and demographic characteristics

Association between patient practices and socio-demographic features were determined using multivariable logistic regression at the chosen level of 0.05. All the questions were correctly answered by 19 (6.8%) patients and 5 (1.8%) patients responded incorrectly to all the questions with a mean attitude score of 12 (out of a maximum of 7 questions, SD 3). The analysis showed that practice score was significantly associated with level of education and monthly income of patients. In adjusted analysis, positive practices towards antibiotic use were associated with the antibiotic misuse with the OR of 1.29 (95% CI: 1.18-1.44). The respondents with higher educational level above high school had 1.21 times lower odds of misuse practices compared to those with lower educational level (OR= 1.21 (95% CI: 1.04-1.42). The significant association between antibiotic use practices and monthly income level higher than Le 2,000,000 was observed with the OR of 0.46(95% CI: 0.24-0.85). (Table 3.4.1

Table 3.4.1 Association of patient's practice scores and demographic characteristics

Demographic variables	Characteristics variables	N (%)	Unadjusted OR (95%CI).	*Unadjusted p* value
Practice scores	Bad Average Good	100 (35.7%) 14 (4.9%) 167 (59.4%)	1.29 (1.18-1.44)	0.001
Gender	Male/female	281 (100%)	0.88(0.65-1.42)	0.930
Age	Below 35 years	115 (40.9%)	0.98(0.67-1.45)	0.936
	Above 35 years	166 (59.1%)		0.935
Education level	Below high school	62 (22%)	0.76 (0.37- 1.56)	4 0.451
	Above high school	219 (78%)	1.21 (1.04-1.42)	0.017
Monthly income (Le)	Below 1,999,000	158 (56.2%)	2.65(0.89- 7.75)	0.089
	Above 2,000,000	123 (43.8%)	0.46(0.24-0.85)	0.016

Patients respondents regression Analyses

Association between patient knowledge, attitude and practice scores and socio-demographic features were determined using Logistic Regression at the chosen level of 0.05, as shown in the tables 3.4.1 above. Of all demographic variables evaluated for associations, gender (OR=1.29; 95% CI: 1.18-1.44) and education (OR=0.44; 95% CI: 0.26-0.73) were found to be significantly affecting knowledge score of respondents. Gender (OR=1.21; 95% CI: 1.04-1.42), education (OR=0.46; 95% CI: 0.24-0.85) and monthly income (OR=3.97; 95% CI: 1.15-13.75) as independent variables were found to be affecting attitude scores. Likewise significant statistical associations were found between the education (OR=1.21; 95% CI: 1.04-1.42) and monthly income (OR=0.46; 95% CI: 0.24-0.85) of patients and mean practice scores. The result of the full model shows a significant effect of the independent variables on the knowledge, attitude and practice score of the patient respondents.

Multiple linear regressionswere used to test if patients' knowledge (awareness) and attitudes (beliefs) significantly predicted their practices (behavior). The fitted regression model was 103.011+ (-0.789) - (0.648). The overall regression was statistically significant {R^2 = [0.71] F(2, 2) = [2.392], p = *[0.029]},* which fail to reject the null hypothesis. It was found out that both patients' knowledge and attitudes significantly predicted their practices/behavior {(β = [0.648], p = [0.016]) and (β = [-0.789], p = [0.031])} respectively.
The results of multiple linear regression analysis of the association between KAP scores showed that each unit increase in Antibiotics use knowledge score was associated with 0.648 increases in the Antibiotics use practice scores (β= 0.648; p= 0.016). For each unit increase of ABR attitudes score, there was -0.789 increase in the scores of ABR practices (β = [-0.789], p = [0.031]). The results showed further that Antibiotics use knowledge scores (β=0.648; p= 0.016) and Antibiotics use attitude scores (β = [-0.789], p = [0.031]) together had a better influence on the increase in Antibiotics use practice scores (β=103.011; p= 0.029) than their independent effect.

Table 3.5 Multiple Linear Regression Analysis Result for patients' respondents

Model summary

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	0.839	0.705	0.410	254.288

ANOVA

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	309372.697	2	154686.348	2.392	0.029
	Residuals	129324.504	2	64662.252		
	Total	438697.200	4			

Coefficients

	Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
		β	Std. Error	Beta		
1	(Constant)	103.011	265.214	1.018	0.388	0.03
	Attitudes (x_1)	-0.789	0.597	-0.647	1.322	0.031
	Knowledge (x_2)	0.648	0.297	0.609	2.185	0.016

Socio-Demographic Characteristics of respondent Prescribers at KGH

A total of 254 questionnaires were completed and returned successfully by the study participants. The majority of the respondents were females 68.5% (n=174), which mostly belong to the age bracket of 36-45

representing 37% (n=94). Over half of the total participants were nurses 61.8% followed by CHO 21.7% and majority had certificates (37%) and diploma (38.6) as the highest level of education, **(Table 3.6)**

Table 3.6 Socio-Demographic Characteristics of respondents Prescribers at KGH

Variables	Categories	Frequencies (%)
Gender	Male	80 (31.5)
	Female	174 (68.5)
Age bracket	Under 25	50 (19.7)
	26-35	80 (31.5)
	36-45	94 (37.0)
	46-55	21 (8.3)
	>55	9 (3.5)
Type of prescriber:	Doctor	10 (3.9)
	CHO	55 (21.7)
	Nurse	157 (61.8)
	Others	33 (12.7)
Highest level of education	Certificate	94 (37.0)
	Diploma	98 (38.6)
	Degree	32 (12.6)
	Masters	5 (2.0)
	Others/specialist	25 (9.8)

ABR related knowledge of prescribers at KGH- (Table 3.7).

A total of 69.0% (n = 175) of the prescribers under study were possessing high knowledge about ABR as compared to 31.0% (n = 79) of prescribers who were placed into low knowledge possessing category. This was denoted when a total of 222 participants(87.4%) agreed that ABR is a worldwide problem. Equally majority agreed that ABR is a problem in their country and in dailypractice (68.5.4% and 68.5%)respectively. Quite a large number (31.5%) of the study participantsdisagreed that ABR is not a significant problem in their daily practice.Larger proportions (75.6%) of respondents think antibiotic-resistant infections could make medical procedures like surgery, organ transplants and cancer treatment much more dangerous and 24.4% believe that prescribing antimicrobial does not cause damage when patients do not need them. When asked about the environmental spread of ABR, approximately 36% of prescribers were not familiar with environmental route of ABR dissemination.

Table 3.7 ABR related knowledge of prescribers practicing at KGH

No.	Statements	Strongly disagree- n (%)	Disagree-n (%)	Neutral- n (%)	Agree- n (%)	Strongly agree- n (%)
1	ABR infections could make medical procedures like surgery, organ transplants and cancer treatment much more dangerous?	0 (0)	36 (14.2)	26 (10.2)	109 (42.9)	83 (32.7)

2	Antimicrobial resistanceis a problem worldwide	0 (0)	24 (9.4)	8 (3.1)	125 (49.2)	97 (38.2)
3	Antimicrobial resistanceis a problem in S/?L	0 (0)	52 (20)	28 (11)	78 (30.7)	96 (37.8)
4	Antimicrobial resistanceis a problem in my daily practice.	0 (0)	53 (20.9)	27 (10.6)	123 (48.4)	51 (20.1)
5	Patients' demands for antibiotics contribute to overuse.	29 (11.5)	40 (15.7)	35 (13.8)	40 (15.7)	110 (48.3)
6	Prescribing antimicrobial does not cause damage when patients do not need them	80 (31.5)	72 (28.3)	40 (15.7)	62 (24.4)	0 (0)
7	I know about the nonclinical/ environmental routes for the spread of ARGs.	0 (0)	28 (11.0)	63 (24.8)	89 (35.0)	74 (29.1)

ABR related prescription behaviors of prescribers at KGH- (Table 3.8).

The distribution of prescriber respondents according to the "good", "average" and "bad" attitudes and practices was found to be56.7% (n= 144), 17.2% (n=44) and 26.1% (n=66) respectively. This was as a result of when about three fourth (76 %) agreed that they frequently prescribe antibiotics at least once a day in the emergency room, outpatient clinic, in the wards or in the community and overthree fourth of therespondents (86.2%) were confident about the optimal use of antibiotics. Two third (64%) of the participants identified that patients demand an antibiotic treatment for a common cold but three fourth of the participants (75.6%) disagreed that patient demands for antibiotics contributed to their overuse. Nearly one third (29.1%) of the respondents reported that they suspect that some antibiotics available in their hospital are of poor quality and for that reason do not work. Most of the participants (77.8%) disagreed that antibiotic guidelines and antibiotic committees are an obstacle rather than a help to clinical care and majority of the participants (63.3%) agreed that the development of local guidelines would be more useful than international guidelines. Only 40.1% admitted they have received some teaching/ training on antibiotics resistance spread during last 2 year and 79.4% agreed on the need for organization of educational/ awareness programs on antibiotic resistance in the community. Most (64.2%) prescribers consider the indication than the availability when prescribing antibiotics for patients and only a small number (47%) of prescribers do not consider the general idea of ABR before prescribing antibiotics.

Table 3.8 ABR related prescription behavior of prescribers at KGH

No.	Statements	Strongly disagree- n (%)	Disagree- n (%)	Neutral- n (%)	Agree- n (%)	Strongly agree- n (%)

No.	Statements	Strongly disagree- n (%)	Disagree- n (%)	Neutral- n (%)	Agree- n (%)	Strongly agree- n (%)
5	Antibiotic guidelines and	121	77	52	4	0
1	I frequently prescribe antibiotics at least once a day in the emergency room, outpatient clinic, in the wards or in the community?	0 (0)	31 (12.2)	30 (11.8)	103 (40.6)	90 (35.4)
2	I feel confident about the optimal prescription of antibiotics	0 (0)	0 (0)	35 (13.8)	121 (47.6)	98 (38.6)
3	Patients demand an antibiotic treatment for a common cold?	0 (0)	158 (62.2)	4 (1.6)	15 (5.9)	77 (30.3)
4	The development of local guidelines would be more useful to me than the international ones to curb antimicrobial resistance.	0 (0)	19 (7.5)	74 (29.1)	38 (15.0)	123 (48.3)

	antibiotic committee (If present) are obstacle more than a help to clinical care.	(47.6)	(30.3)	(20.5)	(1.6)	(0)
6	I suspect that some antibiotics available in my hospital are of poor quality and for that reason do not work	53 (20.9)	64 (25.2)	63 (24.8)	38 (15.0)	36 (14.1)
7	I do consider general knowledge on antimicrobial resistance before prescribing antibiotics for an individual patient	0 (0)	75 (29.5)	45 (17.7)	86 (33.9)	48 (18.9)
8	I feel the need for organization of educational/ awareness programs on antibiotic resistance in the community.	0 (0)	28 (11)	27 (10.6)	175 (70.0)	24 (9.4)
9	During last 2 year, I have received some teaching/ training on antibiotics resistance spread?	53 (20.9)	99 (39.0)	0 (0)	102 (40.1)	0 (0)
10	When prescribing antibiotics, my selection is more affected by the availability than the indication	85 (33.5)	78 (30.7)	9 (3.5)	82 (32.3)	0 (0)

Prescribers' respondents regression Analyses

Simple linear regression was used to test if prescribers' knowledge (awareness) of ABR significantly predicted their antibiotics prescription behavior, the fitted regression model was 216.941+ 0.847. The overall regression was statistically significant {R^2 = [0.78] F(1, 3) = [11.141], p = *[0.044]},* which fail to reject the null hypothesis. It was found that prescribers knowledge significantly predicted their prescription behavior (β = [0.847], p = [0.044]). The results of linear regression analysis of the association between knowledge scores showed that each unit increase in ABR knowledge score was associated with 0.847 increases in the antibiotics prescription behavior scores (β= 0.847; 95% CI: 0.044).

Table 3.9 Linear Regression Analysis Result for prescribers' respondents

Model summary

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	0.887	0.788	0.717	100.558

ANOVA

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	112652.859	1	112652.859	11.141	0.044
	Residuals	30335.940	3	10111.980		
	Total	142988.8	4			

Coefficients

Model		Unstandardized coefficients		Standardized coefficients	t	
		B	Std. Error	Beta		Sig.
1	Intercepts	216.941	97.104	1.018	2.234	0.111
	Knowledge (x_2)	0.847	0.297	0.253	3.334	0.044

Discussion

This is the first cross sectional study to be conducted in the eastern region and perhaps in Sierra Leone, investigating the knowledge, attitudes, and practices of two main players with regards to antibiotics use and the issues of resistance. The findings of this research would provide a clue of the knowledge, attitudes, and patterns of antibiotics usage in the region and maybe the nation as a whole and will also aid in the strategic development of community educational campaigns under the country's national action plan on AMR [51]. This study has also yielded information which may assist in policy formulation and planning interventions to slow down ABR.

In this study, approximately half (48.0%) of the patient respondents are students and about 82% belongs to the youth population (15-30 years). The reason for this high student youth population was probably because the close proximity of the hospital to the eastern technical university and four other populated secondary school and the only government hospital that caters for the entire student population within the township of kenema. The other reason might be as a result of the convenience sampling approach and the inclusion criteria used (those who were interested), and most of the time during the data collection, the older adults and the aged refuse to give consent to participate for reasons such as stress about health outcome, very weak or disinterested.

this study findings denotes that there is a high level (90%) of awareness amongst the patient population with regards to ABR but great misunderstanding exist between antibiotics usage and ABR, this finding was recorded in similar studies done in Jordan and Nepal [**Error! Reference source not found.**, **Error! Reference source**

not found.]. However this was in contrast with a systematic review which indicated that only a small proportion of participants in Europe (43%), Asia (26%) and North America (22%) have ever heard of ABR [24].
This study also shows that, nearly half (47.4%) of the patients' respondents were possessing low knowledge about ABR as compared to 52.6% who were placed into high knowledge possessing category; this was evident when 69.4% of patient participants disagreed that ABR develops when antibiotics no longer work to treat infections and 73.3% agreed that Antimicrobial resistance is the tolerance level of the body after which our body gets used to the antibiotic, about half (43.4%) correctly disagreed with the statements that 'Flu and Common Cold can be cured with a course of antibiotics' and 40%, agreed that "Antibiotics are an effective therapy against viruses". This finding is similar to previous studies done in Sialkot-Pakistan, Kuwait and Ethiopia [40, 491, 51], and elsewhere in Nepal and Tanzania [**Error! Reference source not found.**, **Error! Reference source not found.**].This result shows that confusion exists among the general patient population regarding the accurate knowledge about antibiotics use and resistance. This confusion could have severe implications on antibiotic usage behavior especially when majority of patients in SL relies on over the counter antibiotics for their treatment due to the non-regulated drugstores and pharmacies. In fact excessive and unnecessary use of antibiotics in hospitals and communities of S/L is already well known [39].In this respect therefore, a more robust action of regulations on pharmacies, drug stores is needed particularly in the eastern region and the country at large; as unregulated pharmacies and drug stores in a country can have great implications towards effectively dealing with health threats like ABR.

This study also reveals moderate attitudes towards correct antibiotics use in slightly above half (55.2%) of patient respondents according to their individual responses. This was below the proportions evident in other studies previously done in South Africa, Tanzania [**Error! Reference source not found.**] and in Hong Kong [**Error! Reference source not found.**] and these different in conclusions made regarding the attitude scores was due to the different scoring system explored between our study and these other studies and previous studies conducted in LMICs like Sialkot-Pakistan, Kuwait and Ethiopia etc. [40,491, 51] have recorded similar findings.
There was also a moderate (59.4%) practices (slightly above average) towards rational antibiotics use seen in this study which was as a result of the knowledge and attitudes scores influences and this has been observed in other studies [**Error! Reference source not found.**, 24, **Error! Reference source not found.**]. Increase in age with an increased level of education and income were found to have greatly influenced the KAP scores, however this phenomenon is different as reported in other researches [**Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.**]. OTC access and self - medication was the climax of the odd practices in this study.
AMR stewardship programs can be a key solution to reducing ABR; because it has already been successfully opted in developed countries like USA, China, Canada, and some European countries [**Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Bookmark not defined.**] and such AMR centric stewardship interventions can similarly improve the knowledge and attitude of the general public in SL towards this ABR global threat. Equally in this study, over half of the total prescriber participants were nurses 61.8% and about 68.5% are female. In Sierra Leone, nurses formed about 60-65% of the health workforce and about 90% of these nurses are females; this might be responsible for the high sample of females. Legally, only specialist nurses and advance practicing nurses are allowed to prescribe according to their areas of expertise. However due to the very low doctor patient ratio (1:1,600), high cost of Doctors consultation and the delays in waiting to see doctors, majority of the patients rely on the nurses for alternative health consultations especially at community level. Therefore, most of the OTC antibiotics prescription is done by nurses; this makes them a very vital target population for the prescriber category of this research.
Our study has shown that prescribers' knowledge about ABR is statistically associated with their antibiotics prescription behaviour. Majority (87.4% and 68%) of prescribers at the KGH were found to be well aware

about the global and local threat of ABR respectively and also about 63% recognizes that ABR guidelines designed specifically at local level would be more beneficial than the international ones. These findings are similar to other researches done previously like the one done in Lima- Peru, a systematic review by McCullough and colleagues and Brinsley et al. 2005 where doctors were aware of the problem worldwide but failed to identify it in the local setting [52, **Error! Reference source not found.**, **Error! Reference source not found.**].
In this study 64% of respondents agreed that patients demand antibiotics from them; an evident that prescriber's prescriptions are influenced by the patient's demand of antibiotics. The pressure from patients has been found to influence prescription patterns in middle- and low-income settings and this high expectation about Antibiotics use from patients is probably due to their minimal understanding of ABR and Antibiotics adverse effects. This behavior emphasizes the need for auditing the antibiotic prescriptions in the health care facilities in general and investigating the consultation behavior. It is very important to note that, instead of satisfying the patients by unnecessary prescriptions, patients can always be appeased by making them understand their diseases [**Error! Reference source not found.**]. One such intervention can be developing communication aids for prescriber/ patient interactions. Most (60%) of prescriber participants identified that prescribing Antibiotics can cause some harm to patients who do not need them, although a small number (24%) disagreed; this is in line with a study conducted in the United States among general practitioners which showed that most of the physicians interviewed were aware that inappropriate use of Antimicrobials in their own practice contributes to increasing ABR [53]. The participants identified guidelines and education as key areas to help tackle ABR. Educational forums, local guidelines on antibiotics prescription, available data on local ABR, the need for further research into this crisis, and the importance of the dissemination of all research findings could be useful intervention strategies to curb ABR in SL.
Environmental dimension of AMR/ABR dissemination is currently a major research area and have gained much attention [**Error! Reference source not found.**, **Error! Reference source not found.**], questions regarding the antibiotics disposal and/or return were included in both questionnaires to explore the knowledge regarding environmental route of ABR spread. Over half (60%) of the patient's respondents agreed on disposing off their antibiotics along with the household waste and 36% of prescribers were not conversant with environmental or non-clinical route of ABR spread of ARGs. Disposal of expired and unwanted medicine with general waste and sewerage have also been reported previously [**Error! Reference source not found.**]. Antibiotics discarded in the household waste bins can end up in landfills and may contribute to the development of resistant bacteria [**Error! Reference source not found.**]. Disposal of antibiotics and other drugs down in sinks and toilets can not only negatively influence the aquatic life but also increases the risk of ARGs selection and dissemination into the environment [**Error! Reference source not found.**]. It is therefore extremely critical to ensure the proper and safe disposal of antibiotics. Research on the reasons for medicine disposal would also be helpful not only in terms of gauging the rational prescribing practices of clinicians but also in minimizing wastage of drugs. Lack of the knowledge about environmental or non-clinical route of ABR spread among a significant number of prescribers has also highlighted the need of the educational seminars specifically emphasizing this important driving factor of ABR spread in a community.
The identified low knowledge of antibiotics use and ABR, misuse attitude and abuse practices must be taking into cognizance as a huge problem that orchestrate the high prevalence of ABR and needs urgent attention. Policy and decision-makers could make use of the evidence generated by this study as one of the inputs to reinforce the medicine use policy and guidelines to reduce the risk of ABR. Educational programs for both patients and prescribers which have shown to be successful in a range of settings [**Error! Reference source not found.**] could be an effective intervention in Sierra Leone. Specific groups should be targeted for education programmes, such as those with a lower level of formal education, high income earners and females who have demonstrated less knowledge and destructive attitudes and negative practices to antimicrobial use and measures against their resistance. Education programs could utilize all forms of media, social, television and

radio to run the education campaigns, further research on the most effective tools should be conducted, and proven methods should then be continued. These suggestions show useful pathways that could be used to educate both patients and prescribers on the damage of over prescription, and about the ABR crisis. All interventions should focus on increasing knowledge about ABR; restrict regulations on antibiotics access which could then have an impact on the attitudes, practices of both patients and prescribers.

Strengths and Limitations

This study is important in that it offers insight in to patients' and prescriber's knowledge, attitudes and practices about antibiotics usage and issues of ABR and thus offers comprehensive potential intervention points for the two key players. However there were several limitations to this project; these included the time and resource constraints. The methodology of this project for the patient category place limitations on the generalizability of results; as convenience sampling was used. Selection bias could have occurred as only literate, stable energetic and interested participants would have opted in to complete the survey, and people with certain traits may have been more prone to accepting, such as those who felt confident about their knowledge of ABR. A further selection bias factor that might have likely occur was that only patients who were registered and already at the prescriber's office were requested to complete the survey and these participants could have more knowledge of available treatments such as antibiotics than those who were in the communities. There was no mechanism in place to ensure that people did not complete the survey more than once, but given that the study took some time to complete and there was no specific incentive to participate, double completions were unlikely.

The sample size of doctors and pharmacists' prescribers were very small and so results will only reflect nurses and community health officers' prescribers' knowledge, attitudes and practice or prescribers who were interested in continuing their professional development. The present setting (KGH) was a teaching hospital, and this may not reflect the knowledge and attitudes towards ABR of patients and clinicians in the general community.KAP surveys are limited by the fact that participants may tend to give socially desirable answers rather than expressing their true opinions, but this was minimized as the surveys were anonymous. Further research using alternate sampling methods is needed to remove the effects of these biases and confounders.

Conclusion

Conclusions and Implications for Practice and future Research

The main finding of this study is that there are statistically significant associations between knowledge scores and certain destructive and protective antibiotics use behaviors among both patients and prescribers and therefore if knowledge levels are improved on, it could be possible to influence these behaviors. Designing effective and efficient approaches to effect a positive change among the public towards rational use of antibiotics is very key as knowledge of ABR affect attitudes and practices towards antibiotics use. It is therefore highly anticipated that this study will provide an adequate assessment and potential insights in designing multi-faceted interventions for promoting appropriate antibiotic usage, replenishing the knowledge gaps and correcting the attitudes as part of an effective drive against ABR.

It is evident from this study that patients lack adequate knowledge about ABR followed by the corresponding negative attitudes and practices towards correct use of antibiotics, suggests the need for educational program/awareness campaigns to increase the knowledge level and change the attitudes of the public towards appropriate antibiotic use. This study have also shown that the role of clinicians/health care providers in S/L in appropriate prescribing and counseling on the ideal use of antibiotics should not be overlooked, because the patient's population demand from prescribers, rely and trust providers' decisions in this area.

References

1. Frieden T. Antibiotic resistance threats. *Cdc*. 2013:22-50. Doi: CS239559-B.

2. Togoobaatar G, Ikeda N, Ali M, et al. Survey of non-prescribed use of antibiotics for children in an urban community in Mongolia. *Bull World Health Organ*. 2010;88(12):930-936. doi:10.2471/BLT.10.079004.
3. WHO | Antimicrobial resistance. http://www.who.int/mediacentre/factsheets/fs194/en/. Accessed April 6, 2015.
4. WHO | Antibiotic resistance. http://www.who.int/mediacentre/factsheets/antibiotic-resistance/en/. Accessed November 10, 2015.
5. Davies J, Davies D. Origins and Evolution of Antibiotic Resistance. *MicrobiolMolBiol Rev*. 2010;74 (3):417-433. doi:10.1128/MMBR.00016-10.
6. Laxminarayan R, Duse A, Wattal C, et al. Antibiotic resistance-the need for global solutions. *Lancet Infect Dis*. 2013;13(12):1057-1098. doi:10.1016/S1473-3099(13)70318-9.
7. WHO. Worldwide country situation analysis: response to antimicrobial resistance. *WHO Press*.2015;(April):1-50. doi:ISBN: 978 92 4 156494 6.
8. House W. National Strategy for Combating Antibiotic- Resistant. 2014;(September).
9. Alvarez-Uria G, Gandra S, Laxminarayan R. Poverty and prevalence of antimicrobial resistance in invasive isolates. Int J Infect Dis 2016; 52:59–61, doi:http://dx.doi. org/10.1016/j.ijid.2016.09.026.
10. Ayukekbong JA, Ntemgwa M, Atabe AN. The threat of antimicrobial resistance in developing countries: causes and control strategies. Antimicrob Resist Infect Control 2017;6(1)1–8. . Available from: https://aricjournal.biomedcentral.com/ articles/10.1186/s13756-017-0208-x.
11. Barlam TF, Cosgrove SE, Abbo LM, Macdougall C, Schuetz AN, Septimus EJ, et al. Implementing an antibiotic stewardship program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clin Infect Dis 2016;62(10):e51–77.
12. Begum T, Khan M, Kawser S, Huq M, Majid N, et al. An audit of rational use of antibiotics in a tertiary hospital. Delta Med College J 2014;2(2):64–7.
13. Center for Disease Dynamics Economics & Policy. The State of the world's antibiotics 2015. Cent Dis Dyn Econ Policy. DC: CDDEP Washington; 2015. p. 1–84. . . (Accessed 16 October 2019) https://cddep.org/publications/state_worlds_anti- biotics_2015/.
14. Cox JA, Vlieghe E, Mendelson M, Wertheim H, Ndegwa L, Villegas MV, et al. Antibiotic stewardship in low- and middle-income countries: the same but different?. ClinMicrobiol Infect 2017;23(11):812–8, doi:http://dx.doi.org/ 10.1016/j.cmi.2017.07.010.
15. Khan FA. A prospective study on the antimicrobial usage in the medicine department of a tertiary care teaching hospital. J Clin Diagnostic Res 2013;7 (7):1343–6, doi:http://dx.doi.org/10.7860/JCDR/2013/6265.3125.
16. Kiguba R, Karamagi C, Bird SM. Extensive antibiotic prescription rate among hospitalized patients in Uganda: But with frequent missed-dose days. J AntimicrobChemother 2016;71(6):1697–706, doi:http://dx.doi.org/10.1093/ jac/dkw025.
17. Klein EY, Van Boeckel TP, Martinez EM, Pant S, Gandra S, Levin SA, et al. Global increase and geographic convergence in antibiotic consumption between 2000 and 2015. ProcNatlAcadSci U S A 2018;(March):201717295, doi:http://dx.doi. org/10.1073/pnas.1717295115.
18. Landstedt K, Sharma A, Johansson F, StålsbyLundborg C, Sharma M. Antibiotic prescriptions for inpatients having non-bacterial diagnosis at medicine
19. S. Lakoh et al. / International Journal of Infectious Diseases 90 (2020) 71–76 75departments of two private sector hospitals in Madhya Pradesh, India: a cross-sectional study. BMJ Open 2017;7(4), doi:http://dx.doi.org/10.1136/bmjopen- 2016-012974.
20. Planta MB. The role of poverty in antimicrobial resistance. J Am Board Fam Med 2007;20(6):533–9, doi:http://dx.doi.org/10.3122/jabfm.2007.06.070019.

21. Radyowijati A, Haak H. Determinants of antimicrobial use in the developing world. Child Heal Res Proj Spec Rep 2002;4(1)1–36. . Available from: http://apps.who.int/medicinedocs/documents/s16782e/s16782e.pdf.
22. Welfare F, Bhawan N, Delhi N. National Policy for Containment of Antimicrobial Resistance Developed under the Chairpersonship. 2011 Available from: https://mohfw.gov.in/sites/default/files/3203490350abpolicy%20%281%29.pdf. (Accessed 16 October 2019).
23. Wurie I. Sierra Leone laboratory systems - now and future. Afr J Lab Med 2016;5 (3):1–4, doi:http://dx.doi.org/10.4102/ajlm.v5i3.549. 76
24. Awad AI, Aboud EA. Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. *PLoS One*. 2015;10(2):e0117910. doi:10.1371/journal.pone.0117910
25. Hawkey, P.M., 1998. The origins and molecular basis of antibiotic resistance. BMJ (Clinical research ed.), 317(7159), pp.657–660.
26. Levy, S.B., 1998. The Challenge of Antibiotic Resistance. Scientific American, 278(3): pp 46-
27. O'Neill, J., 2014. Antimicrobial Resistance : Tackling a crisis for the health and wealth of nations. Review on Antimicrobial Resistance, (December), pp.1–16.
28. WHO, 2014. Antimicrobial resistance. Bulletin of the World Health Organization, 61(3), pp.383–94. Available at: http://www.ncbi.nlm.nih.gov/pubmed/22247201%5Cnhttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2536104&tool=pmcentrez&rendertype=
29. Antimicrobial resistance in the WHO African region: current status and roadmap for action - PubMed (nih.gov)
30. World Health Organization. WHO global strategy for containment of antimicrobial resistance. WHO/CDS/CSR/DRS/2001,2
31. Ibrahim RA, Teshal AM, Dinku SF, et al. Antimicrobial resistance surveillance in Ethiopia: Implementation experiences and lessons learned. Afr J Lab Med. 2018;7(2), a770. https://doi.org/10.4102/ajlm.v7i2.770
32. World Health Organization. Stepwise Laboratory Quality Improvement Process Towards Accreditation (SLIPTA) Checklist For Clinical and Public Health Laboratories. 2015. Accessed on 13 November 2017.
33. Takah NF, Shrestha P, Peeling R. The impetus to Africa CDC's mandate in curbing the rising trend of Antimicrobial Resistance (AMR) in Africa: the launch of the Africa CDC AMR surveillance network during the 8th advanced course in diagnostics (ACDx). Pan Afr Med J. 2017 Nov 28;28:271. doi:10.11604/pamj.2017.28.271.14388. PMID: 29942410; PMCID: PMC6011008.
34. Wang Lei, Cao Wei. Analysis of global antibiotic resistance and countermeasures. [J] military medicine. 2017,41 (5): 329-343.
35. WHO | Global action plan on AMR. 2016. https://www.who.int/antimicrobial-resistance/global-action-plan/en/. Accessed 31 Jan 2019.
36. Professional education on antimicrobial prescribing: a report from the Specialist Advisory Committee on Antimicrobial Resistance (SACAR) Professional Education Subgroup. Journal of Antimicrobial Chemotherapy 2007; 60 (Suppl. 1): i27–i32 doi:10.1093/jac/dkm154.
37. Knowledge, attitude, and practice regarding antibiotic use and resistance among medical students in Colombia: a cross-sectional descriptive study | BMC Public Health | Full Text (biomedcentral.com)
38. General Public's Knowledge, Attitude and Practice Survey on Antimicrobial Resistance 2016/17 (chp.gov.hk)
39. SulaimanLakoh, et al, 2019: Antibiotic use among hospitalized adult patients in a setting with limited laboratory infrastructure in Freetown Sierra Leone, 2017-2018

40. Tovokol, M, Dennick R, Making sense of Cronbach's alpha. Int J Med Educ.2011
41. Eugene Kalman Genga et al, 2017: Knowledge, attitudes, and practice survey about antimicrobial resistance and prescribing among physicians in a hospital setting in Nairobi, Kenya available at https://www.researchgate.net/publication/316911381
42. H. Waseem, Jafar Ali, M. Ali et al, 2019: Assessment of knowledge and attitude trends towards antimicrobial resistance (AMR) among the community members, pharmacists/pharmacy owners and physicians in district Sialkot, Pakistan available at https://aricjournal.biomedcentral.com/articles/10.1186/s13756-019-0517-3
43. Dena Firouzabadi, LalehMahmoudi, 2019: Knowledge, attitude, and practice of health care workers towards antibiotic resistance and antimicrobial stewardship programmes: A cross-sectional study. Available at https://pubmed.ncbi.nlm.nih.gov/31115129/)
44. Oumer Abdu Muhie, 2019, Antibiotic Use and Resistance Pattern in Ethiopia: Systematic Review and Meta-Analysis
45. LixiaDuan, Chenxi Liu,Dan Wang, et al, 2021: Systematic Review and Meta-Analysis on the General Population's Inappropriate Behaviors and Misunderstanding of Antibiotic Use in China
46. http://aricjournal.biomedcentral.com/articles10.1186/s/3756-019-0517-3#auth-Jafar-Ali
47. Mazińska B, Strużycka I, Hryniewicz W. Surveys of public knowledge and attitudes with regard to antibiotics in Poland: Did the European Antibiotic Awareness Day campaigns change attitudes? PLoS One. 2017 Feb 17;12(2):e0172146. doi: 10.1371/journal.pone.0172146. PMID: 28212400; PMCID: PMC5315279.
48. Centre for heath protection, department of health, the government of the Hong Kong special administrative region: General Public's Knowledge, Attitude and Practice Survey on Antimicrobial **Resistance 2016/17/https://www.chp.gov.hk/en/static/51310.html** or https://pubmed.ncbi.nlm.nih.gov/31115129/
49. Rizvi T, Thompson A, Williams M, Zaidi STR. Perceptions and current practices of community pharmacists regarding antimicrobial stewardship in Tasmania. Int J Clin Pharm. Springer International Publishing; 2018;40:1380–1387.
50. Shahid A, Iftikhar F, Arshad MK, Javed Z, Sufyan M, Ghuman RS, et al. Knowledge and attitude of physicians about antimicrobial resistance and their prescribing practices in services hospital, Lahore, Pakistan. J Pak Med Assoc. 2017;67:968.
51. National AMR Action Plan for Pakistan, Ministry of National Health Services Regulations. 2017. https://www.nih.org.pk/wp-content/uploads/2018/08/ AMR-National-Action-Plan-Pakistan.pdf. Accessed 31 January 2019.
52. Seid MA, Hussen MS. Knowledge and attitude towards antimicrobial resistance among final year undergraduate paramedical students at University of Gondar, Ethiopia. BMC Infect Dis BioMed Central. 2018;18:312.
53. Garcia C, Llamocca LP, Garcia K, et al. Knowledge, attitudes and practice survey about antimicrobial resistance and prescribing among physicians in a hospital setting in Lima, Peru. *BMC ClinPharmacol*2011; 11: 18.

