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KNOWLEDGE, ATTITUDE, AND PRACTICES ON ANTIBIOTIC RESISTANCE AMONG PHARMACISTS AT THE UNIVERSITY TEACHING HOSPITALS IN LUSAKA, ZAMBIA

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Abstract: Antibiotic resistance is a global public health problem that affects everyone. This study aimed to explore the knowledge, attitude, and practices on antibiotic resistance among pharmacists at the University Teaching Hospitals in Lusaka, Zambia.

This descriptive cross-sectional study was done among 46 randomly selected hospital pharmacists from November 2018 to February 2019. Data was analysed using Statistical Packaging for Social Sciences version 20. Statistical associations were done using Chi-square, Wilcoxon-Mann Whitney and McNemar-Bowker test. Statistical significance was conducted at 95% confidence level with a $p<0.05$ to indicate statistical significance.

The majority of participants 24/46 (52%) were males while 22/46 (48%) were females (p=0.883). Majority of the participants were in the age group of 26-30 years old (p=0.010), the minimum age was 23 and maximum age was 47 years, mean age was 32.11 years, a standard deviation of 6.533, p=0.263. The majority of participants 28/46 (61%) were married (p=0.185), the majority of participants 24/46 (52%) had worked for a period of 1-5 years (p<0.001). All participants 46/46 (100%) were pharmacists (p<0.001) and were all Christians (p<0.001). Majority of the participants had adequate knowledge, positive attitude and good practices towards antibiotic resistance based on their responses to the questionnaire. Statistical tests showed no association between knowledge and attitude (p=0.693), knowledge and practices (p=0.409), and between attitude and practices (p=0.226).

The majority of pharmacists at the University Teaching Hospital in Lusaka have good knowledge, positive attitude and good practices towards antibiotic resistance. Additionally, there was no association between knowledge and attitude (p=0.693), knowledge and practices (p=0.409), and attitude and practices (p=0.226).

Keywords: Antibiotic resistance; Knowledge; Attitude; Practices; Pharmacists

Introduction: Antimicrobial resistance (AMR) is a global public health problem that has been exacerbated by the overuse of antimicrobial agents[1]. Antibiotic resistance (ABR) is a global public health challenge that has led to an increase in morbidity and mortality rates[2]. Antibiotics are routinely used for various infections in hospitals and communities and

hence leading to increased cases of AMR[3,4]. The effectiveness of antibiotics in the management of infections is threatened by the worldwide increase in bacterial resistance[5].

Antimicrobial resistance has led to an ever-increasing and imminent demand for novel antibiotics[6]. Unfortunately, the discovery of newer antibiotics has decelerated in recent years, as a result, only a few antimicrobial drugs have been introduced into clinical practice each year[7]. Two main contributing factors to ABR are excessive consumption of antibiotics and insufficient infection management policies which support the transmission of resistant pathogens[8,9]. Minimizing the inappropriate consumption of antibiotics is an effective strategy for controlling the negative consequences of ABR[10]. Despite an increase in educational programmes on the negative effects of ABR, inappropriate antimicrobial use and overprescribing are increasing[11]. Some consequences of misuse consumption of antibiotics include the evolution of resistance, adverse events, and treatment failures[12]. The World Health Organisation (WHO) recommends initiation and implementation of Antimicrobial Stewardship Programmes (ASPs) in healthcare facilities[12]. Healthcare institutions use ASPs to address factors that may lead to AMR[13]. In 2008, the International Pharmaceuticals Federation (FIP) developed guidelines and set standards with which pharmacists must follow to curb AMR. Pharmacists should be able to give appropriate advice on the use and prescribing of antimicrobials[14]. Therefore, pharmacists need to have adequate knowledge, positive attitudes, and good practices with regards to AMR.

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Some studies on AMR have been done in Zambia and recommended the rational use of antibiotics[15,16,17]. Antibiotic resistance is a global threat that is causing increased morbidity and mortality[1,2,18]. According to the global action plan on ABR[19], AMR has a direct and indirect effect. In Zambia, antimicrobial resistance studies have shown that most bacteria have become resistant to antimicrobials[20].

There are some knowledge, attitude, and practices (KAP) studies that have been done on antibiotic resistance and have highlighted the importance of adequate knowledge, positive attitudes and good practices of healthcare workers to reduce the evolution of resistant bacteria[21,22,23,24]. In Zambia, the only study that was done was on non-prescription sale and dispensing of antibiotics as one causing factor of ABR[16].

Therefore, this study explored the knowledge, attitude, and practices (KAP) on ABR among pharmacists at the University Teaching Hospital (UTH) in Lusaka, Zambia. This study was necessary to conduct in Zambia because it is the first-ever to be published in this area. This study, will, therefore, contribute positively to the existing knowledge on the global challenge of antimicrobial resistance.

Methods

Study Design: This was a descriptive cross-sectional study that was conducted on antibiotic resistance among pharmacists working at the University Teaching Hospital (UTH) in Lusaka, Zambia. A total of 46 participants were randomly sampled from November 2018 to February 2019.

Data collection instrument: Data collection was done using a structured self-administered questionnaire. The questionnaire contained closed-ended questions and was adopted from a study by Rehman *et al*[25]. Dependent variables included knowledge, attitude, and practices whereas independent variables included gender, age, marital status, years of experience, and qualifications of the pharmacists.

Data Analysis and Presentation: Data were entered into Microsoft Excel to create a spreadsheet which was imported in Statistical Packaging for Social Sciences (SPSS) version 20. Chi-square test and a Fisher's exact test were used to determine the association between categorical variables. Chi-square, Wilcoxon-Mann Whitney, and McNemar Bowker test were used to determine relationships of knowledge-attitude, attitude-practice, and practice-knowledge. Statistical significance was performed at 95% confidence level with a p-value < 0.05 that indicated statistical significance.

Ethical Considerations: Ethical clearance to carry out this research was obtained from the University of Lusaka School (UNILUS) Ethics Committee. Before conducting the study, permission was sought from the University Teaching Hospital management through the Senior Medical Superintendent. Before the participants were engaged, they were informed and explained to the purpose and nature of the study. Participants were informed that they had the right to opt out of the study if they wished to do so. Confidentiality and anonymity were maintained and reassured to the participants in that no names appeared on the questionnaires. Besides this, participants benefited from this study because it gave them insight or more information about antibiotic resistance and the rational use of antibiotics. There were no risks or harm to the participants for participating in this study.

Results

Table 1: Sociodemographic Characteristics of participants (n=46)

Demographic Characteristic	n (%)	p-value
Gender		
Males	24 (52.0)	0.883[a]
Females	22 (48.0)	
Age Groups		
21-25	8 (17.4)	0.010[b]
26-30	14 (30.4)	
31-35	10 (21.7)	
36-40	10 (21.7)	
41-45	2.0 (4.30)	
46-50	2.0 (4.30)	
Marital status		
Married	28 (61.0)	0.185[a]
Single	18 (39.0)	
Years of Work Experience	24 (52.0)	0.001[b]
1-5	18 (39.0)	
6-10	4.0 (9.00)	
11-15		

a: non-statistically significant differences in gender and marital status

b: statistically significant differences in age groups and years of experience

Descriptive statistics for the age of the participants

The minimum age of the participants was 23 years, maximum age was 47 years, mean age 32.11, standard deviation 6.533 and p=0.263.

Table 2: Knowledge of Participants with regards to Antibiotic Resistance (n=46)

Variable	A (%)	D (%)	N (%)	SA (%)	SD (%)	p-value
ABR occurs when antibiotics no longer kills bacteria	16 (35)	1 (2)	0 (0.0)	29 (63)	0 (0.0)	<0.001[a]
ABR is caused by inappropriate use of antibiotics	10 (22)	0 (0.0)	0 (0.0)	35 (76)	1(2)	<0.001
ABR will be solved by discovery of new antibiotics	16 (35)	9 (20)	5 (11)	14 (30)	2(4)	0.005
Misuse of antibiotics makes pathogens less sensitive	17 (37)	1(2)	0 (0.0)	28 (61)	0 (0.0)	<0.001
ABR may be caused by lower doses of antibiotics	21(46)	5 (11)	2(4)	15 (33)	3(7)	<0.001
Prescribing antibiotics to treat	19 (41)	11 (24)	4(9)	10 (22)	2(4)	0.010

viral infections leads to ABR						
ABR is caused by overprescribing of broad-spectrum antibiotics	21 (46)	7 (15)	4(9)	14 (30)	0 (0.0)	0.020
Infections caused by resistant bacteria are difficult to treat	15 (33)	0 (0.0)	0 (0.0)	31 (67)	0 (0.0)	0.027
Resistant bacteria may spread from one person to another	16 (35)	9 (19)	4(9)	12 (26)	5 (11)	0.030
Many infections caused by bacteria are resistant to antibiotics	23 (50)	6 (13)	2(4)	15 (33)	0 (0.0)	<0.001

a: statistically significant differences in responses to the knowledge of antibiotic resistance
Abbreviations: A=agree; D=disagree; N=neutral; SA=strongly agree; SD=strongly disagree; ABR=Antibiotic Resistance

Table 3: Attitudes of Participants towards Antibiotic Resistance (n=46)

Variable	A (%)	D (%)	N (%)	SA (%)	SD (%)	p-value
ABR is a serious global public health problem	10 (22)	2 (4)	1 (2)	33 (72)	0 (0.0)	<0.001[a]
Frequent consumption of antibiotics increases chances of ABR	22 (48)	13 (28)	1 (2)	10 (22)	0 (0.0)	<0.001
ABR problems can be reduced by appropriate use of antibiotics	15 (33)	0 (0.0)	0 (0.0)	30 (65)	1(2)	<0.001
Pharmacists should have adequate training on ABR	13 (28)	0 (0.0)	0 (0.0)	23 (72)	0 (0.0)	0.005
Individual efforts have minimal impact on addressing ABR	11 (24)	15 (32.5)	5 (11)	0 (0.0)	15 (32.5)	0.120[b]
Physicians are the only ones to know and understand ABR	0 (0.0)	4(9)	0 (0.0)	4(9)	38 (82)	<0.001
Pharmacists play a prominent role in ABR problems	9 (20)	0 (0.0)	0 (0.0)	37 (80)	0 (0.0)	<0.001

a: statistically significant differences in attitudes of participants towards antibiotic resistance
b: non-statistically significant differences in attitudes of participants towards antibiotic resistance

Abbreviations: A=agree; D=disagree; N=neutral; SA=strongly agree; SD=strongly disagree; ABR=Antibiotic Resistance

Table 4: Practices of Pharmacists towards Antibiotic Resistance (n=46)

Variable	A (%)	D (%)	N (%)	SA (%)	SD (%)	p-value
Dispensing prescribed antibiotics and counsel patients	9 (20)	0 (0.0)	0 (0.0)	37 (80)	0 (0.0)	<0.001[a]
Dispensing antibiotics for longer than the prescribed duration on the request of the patient	2 (4)	16 (35)	0 (0.0)	0 (0.0)	28 (61)	<0.001
Screen antibiotic prescriptions based on local guidelines	21 (46)	2 (4)	0 (0.0)	22 (48)	1(2)	<0.001
Collaboration with other healthcare professionals on ASPs and infections control	22 (48)	2(4)	0 (0.0)	22 (48)	0 (0.0)	<0.001
Communication with prescribers if I am not sure of the appropriateness of an antibiotic prescription	20 (43)	0 (0.0)	0 (0.0)	26 (57)	0 (0.0)	0.461[b]
Sought for additional clinical information such as drug interactions, adverse effects, allergy before dispensing antibiotics	20 (43)	0 (0.0)	0 (0.0)	26 (57)	0 (0.0)	0.461
Participation in antibiotic awareness campaigns	15 (33)	8 (17)	6 (13)	17 (37)	0 (0.0)	0.060
Educating patients on the use of antibiotic and ABR issues	22 (48)	1(2)	0 (0.0)	23 (50)	0 (0.0)	<0.001
Asking patients on their knowledge of the prescribed antibiotics	19 (41)	7 (15)	6 (13)	14 (31)	0 (0.0)	0.020
Recommending formation and implementation of ASPs in all healthcare facilities	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	46(100)	<0.001

a: statistically significant differences in practices of participants towards antibiotic resistance
b: non-statistically significant differences in practices of participants towards antibiotic resistance
Abbreviations: A=agree; D=disagree; N=neutral; SA=strongly agree; SD=strongly disagree; ABR=Antibiotic Resistance; ASPs=Antimicrobial Stewardship Programs

Table 5: Associations between knowledge, attitude, and practices

Variables	Statistical Test	Statistical Test Value	p-value
Knowledge vs Attitude	Chi-Square	3.876	0.693[a]
Knowledge vs Practices	McNemar-Bowker Test	2.889	0.409[b]
Attitude vs Practices	Fisher's Exact Test	7.684	0.226[c]

a: No association between knowledge and attitude
b: No association between knowledge and practices
c: No association between attitude and practices

Discussion

Antimicrobial resistance has been reported to be a global health challenge which requires multi-sectoral contributions and approaches to curbing[1]. The World Health Organisation developed the Global Action Plan to help fight against antimicrobial resistance[19]. This is the first study to explore the knowledge, attitude, and practices of pharmacists working at UTH towards antibiotic resistance.

Sociodemographic Characteristics of Participants: Our study was conducted among 46 hospital pharmacists working at the University Teaching Hospital in Lusaka Zambia. Majority of the participants were males (52%); p=0.883, most of the participants (30.4%) came from the age group of 26-30 years; p=0.010. In Ethiopia, a similar study showed a male predominance (62.7%=males; 37.3%=females)[26]. Another KAP study on antibiotic resistance showed a male predominance[13]. A similar study in Pakistan showed a male predominance (80.1%=males) and the majority of participants were from the age group of 20-30 years[25]. Khan *et al*. found that the majority of pharmacists were females representing 54.8% and the majority being in the age group of 20-30 years (76.6%)[27]. The minimum age was 23 years, maximum age was 47 years, mean age was 32.11 years, a standard deviation of 6.533 and a p-value=0.263. The p-value for age group shows that age is not a significant predictor of pharmacists' KAP on antibiotic resistance. Our findings were similar to another study findings in Ethiopia with a p=0.354 that was not a good predictor of antibiotic resistance[13]. Therefore, this suggests that age is not a good predictor of knowledge, attitude, and practices towards antibiotic resistance among pharmacists at UTH in Zambia and the comparative study in Ethiopia.

This study at UTH in Zambia revealed that the majority of pharmacists were married (61%); p=0.185 and the majority (52%) have had worked for a period of 1 to 5 years; p=0.001. Other studies found similar results[13,25]. These age groups where the majority of pharmacists came from could suggest that many young people were enrolling in the profession of pharmacy. All the participants were qualified pharmacists with a Bachelor of Pharmacy degree and were all Christians p<0.001. These findings were in contrast to what Rehman *et al*. found in which the majority of the participants were holders of Doctor of Pharmacy Degrees[25]. Khan *et al*. reported that all the participants were qualified pharmacists with a Bachelor's Degree[27]. Hence, this difference in qualifications may affect the knowledge, attitude, and practices of pharmacists towards antibiotic resistance.

Knowledge of Pharmacists on Antibiotic Resistance: Our results revealed that the majority of pharmacists (63%) strongly agreed that antibiotic resistance occurs when antibiotics cannot treat bacterial infections. A p<0.001 gave statistical significance. These findings are in tandem with the findings of other researchers[13,26]. These findings are similar because antibiotics are overused worldwide. The majority of pharmacists (76%) strongly agreed that the inappropriate use of antibiotics may lead to antibiotic resistance. A p<0.001 gave statistical significance. These results are similar to the results reported by other researchers[13,16,23,28,29,30]. Inappropriate use of antibiotics is well known to be one of the leading factors that cause antibiotic resistance[1,19]. Thus, pharmacists need to recommend the rational use of antibiotics.

In our study, the majority of pharmacists (35%) agreed that the discovery of new antibiotics can help solve antibiotic resistance challenges. A p=0.005 gave statistical significance. These results were similar to the findings of Tegagn *et al*. though with a lower percentage of 31% compared to 35% in this study[13]. Discovery of new antimicrobials for use into clinical practice has declined over the past decades[31]. Discovery of alternative antibiotics is a key in reducing antibiotic resistance but it is not the only alternative to fighting antibiotic resistance. If new antibiotics were to be discovered, other

practices such as irrational dispensing, prescribing, regulation and consumption of antibiotics need to be improved. The majority of pharmacists (61%) strongly agreed that the misuse of antibiotics leads to antibiotic resistance. A p<0.001 gave statistical significance. Many other studies have shown that misuse of antibiotics may lead to antibiotic resistance[11,13,16,26,29]. The entire world needs to avoid misuse of antibiotics if this global public health challenge of antibiotic resistance has to be eliminated.

This current study reported that the majority of pharmacists (46%) agreed that prescribing and dispensing of lower doses of antibiotics leads to antibiotic resistance with a p<0.001. Mansour & Al-Kayali reported that more than 95% pharmacists agreed that prescribing of lower antibiotic doses of antibiotics leads to antibiotic resistance[22]. Kalungia *et al*. reported that dispensing of lower doses of antibiotics may lead to antibiotic resistance[16]. This is because lower doses of antibiotics cannot kill the bacteria.

Studies have shown that prescribing antibiotics empirically to treat viral infections may lead to antibiotic resistance[22,29]. These findings are in tandem with the findings of our study in which the majority of pharmacists (41%) agreed. A p=0.001 gave statistical significance. Viruses themselves may be carriers of resistant genes which may be transmitted to bacteria. Our study found that the majority of pharmacists (46%) agreed that prescribing and dispensing of broad-spectrum antibiotics may lead to antibiotic resistance (p=0.002). This is in line with other studies[13,22]. Therefore, overprescribing and dispensing of broad-spectrum antibiotics must be avoided and only done when bacterial susceptibility tests are done. Our study indicated that 67% pharmacists strongly agreed while 33% agreed that infections caused by resistant bacteria may be difficult or impossible to treat (p=0.027). This is similar to the results published in other studies.[13,32,33] Thus, the need to avoid the emergence of antibiotic-resistant bacteria as stipulated in the WHO Global Action Plan against AMR[19].

Studies have shown that resistant bacteria can be transmitted from one person to another[16,32,33]. This is in line with the findings of our study which showed that majority of the pharmacists (35%) agreed that resistant bacteria can spread from one person to another with a p=0.030. Finally, our results indicated that the majority of pharmacists (50%) agreed that most bacterial infections have become resistant to antibiotics. A p<0.001 gave statistical significance. These results are similar to the results that were reported by other researchers[13,34]. The WHO has also reported that many infections are now becoming resistant to antibiotics and has since developed the Global Action Plan against AMR[19].

Attitudes of Pharmacists towards Antibiotic Resistance: Our findings indicated that 72% of pharmacists strongly agreed that AMR is a serious public health problem. A p<0.001 gave statistical significance. These results were similar to the findings of Tegagn *et al*. though a lower percentage (44.9%) of those who strongly agreed was recorded[13]. Other studies also reported AMR as a public health problem[16,21,22,35,36]. A global challenge requires all countries to work together in fighting the problem. Our findings showed that most of the pharmacists (48%) agreed that the use of antibiotics increases the risks of emergence of antibiotic-resistant bacteria. A p<0.001 gave statistical significance. Taking antibiotics increases the risks of emergence of resistant bacteria to antibiotics[13,16].

In our study, 65% of pharmacists strongly agreed that the appropriate use of antibiotics can reduce problems of AMR with a p<0.001. Similar studies reported that the appropriate use of antibiotics may help reduce problems of AMR[16,36]. Consumption of antibiotics increases the chances of causing bacteria to develop antibiotic-resistant genes and thus the call for appropriate, prudent and rational use of antibiotics. Our study further showed that 72%

of pharmacists strongly agreed while 28% agreed that adequate training for pharmacists on antibiotic resistance must be provided. A p=0.005 gave statistical significance. These findings are in line with what was found by Rehman *et al*. in which the majority of pharmacists (61.9%) strongly agreed that adequate training on antibiotics resistance must be provided to pharmacists[25]. Another study in Malaysia reported that 87.7% of pharmacists strongly agreed that pharmacists need more educational activities with regards to antibiotic resistance[27]. Additional adequate educational activities on rational antibiotic use and antibiotic resistance must be provided to the pharmacists so that they can help positively in reducing cases of AMR.

Our study reported that 32.5% pharmacists disagreed while 32.5% strongly disagreed that individual impacts have minimal impacts in fighting AMR. These findings are in contrast to the findings of other researchers. Most of the pharmacists (40.9%) agreed that individual efforts have minimal impacts on curbing AMR[25]. The majority of the pharmacists were neutral on the impact of individual efforts in fighting AMR[27]. The WHO and the Food and Agricultural Organisation of the United Nations (FAO) recommend that collaborations among healthcare providers, institutions, governments, organisations, etc have better results and major positive impacts in fighting antibiotic resistance[37]. In this study, 82% pharmacists strongly disagreed with the notion that physicians are the only healthcare professionals who must understand AMR. Another study reported similar findings[25].Therefore, this shows that antibiotic resistance should be understood and prevented by all healthcare professionals and other sectors other than the healthcare sector. In our study, 80% of pharmacists strongly agreed that pharmacists have a prominent role to play in fighting antibiotic resistance and control infections. A p<0.001 gave statistical significance. Other studies found similar findings[25,27,36,38]. The International Pharmaceuticals Federation (FIP) and WHO has also recommended prominent roles which pharmacists must play to curb antibiotic resistance.

Practices of Pharmacists on Antibiotic Resistance: In our study, 80% pharmacists strongly agreed while 20% agreed that they dispense prescribed antibiotics and counsel patients on the rational use of the prescribed antibiotics. A p<0.001 gave statistical significance. These findings are slightly similar to the findings of Rehman *et al*[25]. The FIP recommends that pharmacists dispense the prescribed antibiotics and counsel the patients on the rational use of antibiotics. Our study revealed that 61% pharmacists strongly disagreed that they dispense antibiotics for longer than the prescribed duration upon request by the patient. A p<0.001 gave statistical significance. A similar study found similar findings[25], while another found different results[27]. Pharmacists have vast knowledge in the use of medicines such as antibiotics but dispensing of an additional duration of the prescribed antibiotics at the request of the patient is unethical and must not be practiced.

Our study revealed that the majority of pharmacists (48%) strongly agreed while (46%) agreed that they screen antibiotic prescriptions and dispense prescribed antibiotics following the standard guidelines for dispensing antibiotics. A p<0.001 gave statistical significance. Similar findings were reported in other studies[13,25]. Screening of prescriptions based on standard guidelines is very important before dispensing antibiotics.

Our study revealed that the majority of pharmacists (48%) agreed and another (48%) strongly agreed that they collaborate with other healthcare professionals in infection control and Antimicrobial Stewardship Programmes (ASPs) with a p<0.001. Other researchers found similar results[25,27,39,40]. This is important as infection control and fighting of antimicrobial resistance requires a multi-sectoral approach and collaboration among healthcare practitioners[37].

In our study, 57% pharmacists strongly agreed while 43% agreed that they communicate with prescribers on the appropriateness of prescribed antibiotics with a p=0.461. A study by Laible *et al*. reported similar findings[39]. Rehman *et al*. reported different findings in which the majority of pharmacists (32%) agreed that they communicate with prescribers on the appropriateness of prescribed antibiotics. This is important as the rational prescribing of antibiotics reduces the emergence of antibiotic-resistant bacteria. Communication among healthcare practitioners is vital if we have to prevent and reduce the further emergence of antibiotic-resistant bacteria. In our study, 37% pharmacists strongly agreed while 33% agreed that they participate in antibiotic awareness campaigns with a statistical significant p=0.060. A similar study reported similar findings[25], while another reported different findings[27]. These differences could mean that the pharmacists need to be encouraged and informed on the importance of taking part in antibiotic awareness campaigns.

Our study found that the majority of pharmacists (57%) strongly agreed while 43% agreed that they check for drug interactions, adverse effects, and allergy to the prescribed antibiotics before dispensing. A p=0.461 gave statistical significance. A similar study found similar results.[25] Drug interactions may occur between drugs and food, drugs and beverages, drugs and herbal medicines, etc, and thus pharmacists and all healthcare professionals need to be on the lookout as this may also lead to AMR. Our study reported that 50% of pharmacists strongly agreed that they educate patients on antibiotics and AMR with a statistically significant p<0.001. Other studies have reported that pharmacists educate patients on AMR[25,39]. Patients are the vital members of interaction in the healthcare system and thus need to be educated on the rational use of antibiotics and antibiotic resistance. Our findings reported that most of the pharmacists (41%) agreed while 31% strongly agreed that they ask patients on knowledge of prescribed antibiotics and their usage. A p=0.020 gave statistical significance. These findings are similar to other findings[25,39]. Antibiotic resistance may be fostered by a patient's lack of knowledge on antibiotic use and resistance. Thus, the pharmacists who engage patients on antibiotic use and resistance help reduce escalating cases of antibiotic-resistant infections, morbidity and mortality rates.

All the pharmacists in our study recommended that Antimicrobial Stewardship Programmes (ASPs) must be initiated and implemented in all healthcare facilities with a statistically significant p<0.001. Other studies have also shown that pharmacists recommended the initiation and implementation of ASPs[13,16,24,25,40]. The WHO has also emphasised that ASPs must be implemented in healthcare facilities and they play a vital role in fighting AMR[1]. Pharmacists must play a key role in ASPs[42,43]. Therefore, the formation and implementation of ASPs in all healthcare facilities must be recommended and emphasised in Zambia.

Therefore, our study indicated that pharmacists working at the University Teaching Hospital have adequate knowledge, positive attitude, and good practices towards antibiotic resistance. These findings are in tandem with other results found in other studies[22,27,28,29]. Additionally, to fight AMR, pharmacists need to have adequate knowledge, positive attitudes, and good practices towards antibiotic use resistance. However, some studies have reported different findings in which pharmacists showed poor knowledge and bad practices towards antibiotic use and resistance[44,45,46].

Associations between knowledge, attitudes, and practices of pharmacists with regards to antibiotic resistance

This study showed that there was no association between knowledge and attitude (p=0.693), knowledge and practices (p=0.409) and attitude and practices (p=0.226). All p-values evidence this as they were greater than 0.05. A study by

Tegagn *et al*. (2017) also found no association between knowledge and attitude (p=0.229), knowledge and practice (p=0.921), and attitude and practice (=0.915)[13]. Studies have also shown that pharmacists may have adequate knowledge, positive attitude, and good practices towards antibiotic resistance. Though, no association between knowledge and attitude, knowledge and practices, and attitude and practices may exis[27].

Limitations of the study: The results of this study which was done in one hospital cannot be generalised as a representation of all hospitals in Zambia. Another limitation was that this study only focused on pharmacists leaving out the rest of the healthcare professionals.

Conclusions: The study concluded that the majority of pharmacists at the University Teaching Hospital in Lusaka have good knowledge, positive attitude and good practices towards antibiotic resistance. Additionally, there was no association between knowledge and attitude (p=0.693), knowledge and practices (p=0.409) and attitude and practices (p=0.226). Finally, based on the findings of this study, Antimicrobial Stewardship Programmes must be developed and implemented at the University Teaching Hospital and all health facilities so that resistance to antibiotics can be curbed. Pharmacists and other healthcare workers need to be updated on antimicrobial resistance.

Ethics approval and consent to participate

The University of Lusaka Ethics committee did ethical approval in Lusaka, Zambia.

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Authors' contributions: SM conceptualized and developed the design of the study. SM did data collection. SM and MB analysed and interpreted the data. SM, MB, FFB, and JS did the drafting of the manuscript. All authors read and reviewed the initial manuscript and approved the final version of the manuscript.

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