BIBLIOGRAPHIC INFORMATION SYSTEM

Journal Full Title: Journal of Biomedical Research & Environmental Sciences

Journal NLM Abbreviation: J Biomed Res Environ Sci

Journal Website Link: <https://www.jelsciences.com>

Journal ISSN: 2766-2276

Category: Multidisciplinary

Subject Areas: Medicine Group, Biology Group, General, Environmental Sciences

Topics Summation: 128

Issue Regularity: Monthly

Review Process type: Double Blind

Time to Publication: 7-14 Days

Indexing catalog: [Visit here](#)

Publication fee catalog: [Visit here](#)

DOI: 10.37871 ([CrossRef](#))

Plagiarism detection software: [iThenticate](#)

Managing entity: USA

Language: English

Research work collecting capability: Worldwide

Organized by: [SciRes Literature LLC](#)

License: Open Access by Journal of Biomedical Research & Environmental Sciences is licensed under a Creative Commons Attribution 4.0 International License. Based on a work at SciRes Literature LLC.

Manuscript should be submitted in Word Document (.doc or .docx) through **Online Submission** form or can be mailed to support@jelsciences.com

Vision

Journal of Biomedical Research & Environmental Sciences main aim is to enhance the importance of science and technology to the scientific community and also to provide an equal opportunity to seek and share ideas to all our researchers and scientists without any barriers to develop their career and helping in their development of discovering the world.

RESEARCH ARTICLE

Knowledge, Attitude, and Practices of Community Pharmacists on Antibiotic Resistance and Antimicrobial Stewardship in Lusaka, Zambia

Steward Mudenda^{1,2*}, Mutinta Hankombo⁶, Zikria Saleem³, Mohammad Jaffar Sadiq⁴, Michelo Banda¹, Derick Munkombwe¹, Chiluba Mwila¹, Maisa Kasanga^{5,6}, Annie Chibwe Zulu⁷, Jimmy Mapenzi Hangoma^{6,8}, Webrod Mufwambi¹, Lungwani Tyson Muungo¹, Ronald Mutati Kampamba¹, Andrew Munkuli Bambala^{6,9}, Noor Mohammed Abdulrahman¹⁰, Muhammad Akram¹¹, Christabel Nang'andu Hikaambo¹ and John Bwalya Muma²

¹University of Zambia, School of Health Sciences, Department of Pharmacy, P.O. Box 50110, Lusaka, Zambia

²University of Zambia, School of Veterinary Medicine, Department of Disease Control, P.O. Box 32379, Lusaka, Zambia

³Department of Pharmacy Practice, Faculty of Pharmacy, the University of Lahore, Lahore, Pakistan

⁴Department of Pharmacology, Batterjee Medical College for Science and Technology, Jeddah, Saudi Arabia

⁵Zhengzhou University, College of Public Health, 100 Kexue Avenue, Zhengzhou, Henan 450001 China

⁶University Teaching Hospitals, P/Bag RW 1X, Lusaka, Zambia

⁷Levy Mwanawasa University Teaching Hospital, Department of Pharmacy, P.O. Box 37084, Lusaka, Zambia

⁸Levy Mwanawasa Medical University, School of Health Sciences, Department of Pharmacy, Lusaka, Zambia

⁹University Teaching Hospitals, P/Bag RW 1X, Hospital Pharmacists Association of Zambia (HoPAZ), Lusaka, Zambia

¹⁰University of Basrah, College of Pharmacy, Department of Clinical Pharmacy, Iraq

¹¹Government College University Faisalabad, Department of Eastern Medicine, Pakistan

ABSTRACT

Background: Antimicrobial/Antibiotic Resistance (AMR) is among the major threats to global health. Due to limited information on the subject matter in Zambia, we assessed the knowledge, attitude, and practices of community pharmacists on AMR and Antimicrobial Stewardship (AMS).

Materials and Methods: We conducted a descriptive cross-sectional study among 144 randomly selected community pharmacists through a structured questionnaire. Data were analysed using Statistical Package for Social Sciences version 22 at a 95% confidence level. The Fisher's exact test was used to determine the relationship between sociodemographic factors of community pharmacists and their knowledge, attitude, and practices on antibiotic resistance and antimicrobial stewardship.

Results: A response rate of 91% ($n = 144$) was achieved. Interestingly, 93.8% had good knowledge while 67% had positive attitudes regarding AMR and AMS. Conversely, 75% of the community pharmacists demonstrated poor practices towards AMR and AMS. The majority of the CPs 69.4% agreed that antibiotic resistance is a public health problem. The majority of the CPs 57.6% agreed that the appropriate use of antibiotics improves patient care and outcome. Of concern, (32.6%) of CPs rarely collaborated with other healthcare workers in activities that promote infection control and AMS. Also, the majority of the CPs did not take part in antibiotic awareness campaigns nor educate the public on antibiotic use and over 80% of CPs regularly issued antibiotics without a prescription.

Conclusions: Even though community pharmacists had good knowledge and positive attitudes, they demonstrated poor practices that require quick educational interventions. As most CPs issue antibiotics without a prescription, this should be highlighted as a major policy issue on AMR and should be addressed by the Government. There is a need to promote AMS sensitization programmes among community pharmacists.

*Corresponding author

Steward Mudenda, Department of Pharmacy, School of Health Sciences, University of Zambia, P.O. Box 50110, Lusaka, Zambia

Tel: +260-977-549-974

E-mail: freshsteward@gmail.com

DOI: 10.37871/jbres1343

Submitted: 21 October 2021

Accepted: 29 October 2021

Published: 30 October 2021

Copyright: © 2021 Mudenda S, et al. Distributed under Creative Commons CC-BY 4.0

OPEN ACCESS

Keywords: Antimicrobial resistance; Antibiotic resistance; Antimicrobial stewardship; Attitude; Community pharmacists; Knowledge; Practices; Zambia

GENERAL SCIENCES

COMMUNITY HEALTH

VOLUME: 2 ISSUE: 10 - OCTOBER

How to cite this article: Mudenda S, Hankombo M, Saleem Z, Sadiq MJ, Banda M, Munkombwe D, Mwila C, Kasanga M, Zulu AC, Hangoma JM, Mufwambi W, Muungo LT, Kampamba RM, Bambala AM, Abdulrahman NM, Akram M, Hikaambo CN, Muma JB. Knowledge, Attitude, and Practices of Community Pharmacists on Antibiotic Resistance and Antimicrobial Stewardship in Lusaka, Zambia. J Biomed Res Environ Sci. 2021 Oct 30; 2(10): 1005-1014. doi: 10.37871/jbres1343, Article ID: JBRES1343, Available at: <https://www.jelsciences.com/articles/jbres1343.pdf>

INTRODUCTION

The decline in the introduction of new antibiotics on the market in the past decades has posed a great threat to the treatment of infectious diseases [1]. Antibiotic resistance is currently a global health issue that calls for urgent attention because effective treatment of infectious diseases is an essential component of both human and animal health management [2-4]. The impact of antibiotic resistance includes increased resource utilization, clinical or economic burdens, and increased use of broad-spectrum antibiotics, increased morbidity, and mortality [5]. Although antibiotic resistance is an inevitable consequence of antibiotic use, the rate and extent of propagation of resistant bacteria are governed by human behaviour such as excessive and inappropriate use of antibiotics in health systems [6]. Inappropriate use of antibiotics is directly related to the tendency towards self-medication and the unnecessary use of antibiotics for viral diseases [7].

It has been observed that most people suffering from viral upper respiratory tract infections such as common colds tend to misuse antibiotics for treatment [8,9]. This irrational use of antibiotics for some respiratory tract diseases escalates cases of antibiotic-resistant bacteria [10]. Being among respiratory tract infections, Coronavirus Disease 2019 (COVID-19) is likely to escalate antibiotic resistance due to an expected over-prescribing, inappropriate use, and self-prescription of antibiotics [11-14]. Strategies must be implemented for the management of upper respiratory tract infections and to reduce the inappropriate consumption of antibiotics [15]. Therefore, prescribers and all healthcare workers need to be watchful as they prescribe and dispense antibiotics even in times of global pandemics.

Community Pharmacists (CPs) are the first point of contact for community members seeking pharmaceutical and medical services due to their ease of accessibility, less waiting time, and cheaper costs [16-19]. Nevertheless, members of the community find it easier to access the CPs and acquire their medical help [20]. It is noteworthy that members of the community trust the CPs and thus obtain their antibiotics through interaction with CPs [21]. In developing countries, there has been an increase in the use of non-prescribed antibiotics which has been exacerbated by non-prescription sales of antibiotics in community pharmacies [22,23]. Global estimations have indicated that more than 50% of antibiotics are accessed privately without a prescription; with increasing evidence indicating that CPs are failing to promote the rational and appropriate use of antibiotics [24-26].

The supply of antibiotics from a community pharmacy without a prescription usually involves interaction with a community pharmacist [27,28]. The problem of dispensing antibiotics without a prescription has been reported in

low-and middle-income countries [29,30]. Therefore, changing the publics' attitudes and improving their knowledge regarding antibiotic use is the responsibility of the community pharmacist who happens to be the first point of contact and source of these antibiotics [31]. Emphasis has therefore been placed on improving the role of the pharmacist as the main supplier and regulator of antibiotics in communities [32].

Being a global health problem, it is therefore important that CPs have good knowledge, a positive attitude, and good practices (KAP) towards antibiotic resistance [33,34]. The KAP model acknowledges that the knowledge of an individual positively influences their attitude and the attitude, in turn, influences their practices or behaviour. However, solving the problem of antibiotic resistance requires that health systems initiate and implement Antimicrobial Stewardship Programmes (ASPs) [35,36]. CPs may play a crucial role in the fight against antimicrobial resistance by acting as proponents of ASPs [37-39]. ASPs promote the rational use of antibiotics and reduce antibiotic resistance [40,41]. As a member of the medical community, CPs must act positively in the fight against antibiotic resistance by embracing and participating in ASPs [42-44].

In the Zambian setup, there is limited information on the knowledge, attitude, and practices of community pharmacists on antibiotic use and resistance, and ASPs. Therefore, this study may offer benefits to Zambian pharmacists and all pharmacists globally. This study is also of benefit to other healthcare workers because antibiotic resistance affects everyone. CPs should promote the rational use of antibiotics even in times of global health pandemics to prevent the worsening of the emergence of antibiotic-resistant bacteria. Therefore, we assessed the knowledge, attitude, and practices of community pharmacists on antibiotic resistance and antimicrobial stewardship.

MATERIALS AND METHODS

Study design and site

This was a descriptive cross-sectional study that was conducted in community pharmacies in Lusaka Zambia from March 2019 to August 2019. Lusaka is the Capital city of Zambia and has more than 50% of registered community pharmacies in Zambia [45]. The study involved registered CPs who provided consent to participate in the study. Pharmacy technologists, dispensers, unregistered pharmacies, and drug stores were excluded from this study.

Sample size

The sample size was calculated using Slovin's formula [46]. The sample size calculation was done at a 95% confidence level and a 5% margin of error. However, a 10% surplus was added to the sample size to overcome challenges

associated with non-response and incomplete responses. The community pharmacists were chosen using simple random sampling from a total of 225 registered community pharmacies in Lusaka at the time of the study as was obtained from the Zambia Medicines Regulatory Authority (ZAMRA) Register [45].

Data collection tool: structure self-administered questionnaire

Data collection was done using a structured self-administered questionnaire. The questionnaire was adopted and modified from similar studies [33,47]. The questionnaire was pre-validated for its simplicity, accuracy, clarity, understandability, and relevance by experts in the field of pharmacy. This gave room for modification of the initial questionnaire. Later, the questionnaire was pretested among 12 community pharmacists for its consistency. Then the final structured questionnaire was used to collect data on sociodemographic characteristics, knowledge, attitude, and practices of community pharmacists on antibiotic resistance and AMS. The responses on knowledge and attitude questions were measured using a 5-point Likert-scale as follows; 1= 'strongly disagreed', 2= 'disagreed', 3= 'neutral', 4= 'agreed', and 5= 'strongly agreed'. The responses on practice questions were measured using a Likert scale as follows; 1= 'never', 2= 'rarely', 3= 'occasionally', 4= 'often', and 5= 'always'. Reverse coding was done for negatively worded questions. Scores for knowledge ranged from 5 to 25, scores equal to or above 12 indicated good knowledge while scores below 12 indicated poor knowledge. Scores for attitude ranged from 6 to 30, scores equal to or above 15 indicated positive attitude while scores below 15 indicated negative attitude. Scores for practices ranged from 7 to 35, scores equal to or above 17 indicated good practices while scores below 17 indicated poor practices. Dependent variables included knowledge, attitude, and practices. Independent variables included age, sex, level of education, and work experience.

Statistical analysis

The data were analysed using Statistical Package for the Social Sciences (SPSS) version 22.0. Data was initially entered into the Microsoft Excel spreadsheet before being exported to SPSS. Data was presented in form of tables and charts and a Likert scale was used to determine the level of knowledge, attitude, and practices. A $p < 0.05$ was used to indicate statistical significance at a 95% confidence level. Fisher's exact test was used to determine the relationship between categorical variables.

RESULTS

Demographic characteristics of participants

The demographic characteristics of 144 Community Pharmacists (CPs) who took part in the study are shown in

Table 1: Sociodemographic characteristics of participants (n = 144).

Variable	Category	Frequency (%)	p-value
Sex	Male	91 (63)	0.002
	Female	53 (37)	
	20 - 29	28 (19)	
Age	30 - 39	94 (65)	< 0.0001
	40 - 49	18 (13)	
	≥ 50	4 (3)	
Education level	Degree	134 (93)	< 0.0001
	Masters	10 (7)	
	1 - 4	54 (38)	
Work experience (years)	5 - 9	64 (44)	< 0.0001
	≥ 10	26 (18)	

table 1. Most of the respondents were male (63%) and were aged between 30 and 45 years (65%).

Table 2 shows that the majority of the CPs 93.8% (n = 135) had good knowledge and 67.4% had a positive attitude with regards to antibiotic resistance. Unfortunately, 75.7% of the CPs had poor practice regarding antibiotic resistance and antimicrobial stewardship (Table 2).

Table 3 shows that the majority of the CPs (29.2% agreed, 67.4% strongly agreed) that antibiotic resistance occurs when antibiotics no longer work to treat bacterial infections. The majority of the CPs (29.7% agreed, 69.7% strongly agreed) that antibiotic resistance occurs due to misuse of antibiotics and it is a public health problem in our communities (Table 3).

Table 4 indicates that the majority of the CPs 69.4% agreed that antibiotic resistance is a public health problem. The majority of the CPs 57.6% agreed that the appropriate use of antibiotics improves patient care and outcome (Table 4).

Table 5 indicates that the majority of the CPs (32.6%) rarely collaborates with other healthcare workers in activities that promote infection control and AMS. In addition, the majority of the CPs do not take part in antibiotic awareness campaigns nor educate the public on antibiotic use (Table 5).

Table 6 shows that there was a statistical significance between age and attitude, age and practices, work experience and knowledge, and work experience and practices (Table 6). The knowledge of CPs on AMR and AMS was associated

Table 2: Overall knowledge, attitude, and practice scores on antibiotic resistance and AMS.

Variable	Good (n, %)	Poor (n, %)
Knowledge	135 (93.8%)	9 (6.2%)
Attitude	97 (67.4%)	47 (32.6%)
Practice	35 (24.3%)	109 (75.7%)

Table 3: Community pharmacists' knowledge of antibiotic resistance.

Variable	Responses				
	SD (%)	D (%)	N (%)	A (%)	SA (%)
Antibiotic resistance is when antibiotics no longer work to treat bacterial infections	00 (0.0)	3 (2.0)	2 (1.4)	42 (29.2)	97 (67.4)
Misuse of antibiotics leads to a loss of sensitivity of an antibiotic to a specific pathogen	00 (0.0)	00 (0.0)	00 (0.0)	43 (29.9)	101 (70.1)
Antibiotic resistance is a problem in our community	00 (0.0)	00 (0.0)	1 (0.7)	36 (25)	107 (74.3)
Bacteria that are resistant to antibiotics can spread from person to person	2 (1.4)	5 (3.5)	12 (8.3)	38 (26.4)	87 (60.4)
Many infections are becoming increasingly resistant to treatment using antibiotics	00 (0.0)	00 (0.0)	8 (5.6)	66 (45.8)	70 (48.6)
SD: Strongly Disagree; D: Disagree; N: Neutral; A: Agree; SA: Strongly Agree					

Table 4: Community pharmacists' attitude towards antibiotic resistance.

Variable	Responses				
	SD (%)	D (%)	N (%)	A (%)	SA (%)
Antibiotic resistance is a serious public health problem	00 (0.0)	00 (0.0)	00 (0.0)	100 (69.4)	44 (30.6)
Appropriate use of antibiotics can improve patient care and outcome	00 (0.0)	00 (0.0)	00 (0.0)	83 (57.6)	61 (42.4)
Appropriate use of antibiotics can reduce problems of antibiotic resistance.	00 (0.0)	00 (0.0)	00 (0.0)	87 (60.4)	57 (39.6)
Adequate training on antibiotic resistance should be provided to retail pharmacists	00 (0.0)	8 (5.6)	43 (29.9)	66 (45.8)	27 (18.8)
Relevant conferences, workshops, and other educational activities are required to be attended by retail pharmacists to enhance their understanding of antibiotic resistance.	00 (0.0)	16 (11.1)	38 (26.4)	64 (44.4)	26 (18.1)
Pharmacists have a responsibility to take a prominent role in antibiotic resistance and infection-control programs in the health system.	00 (0.0)	00 (0.0)	1 (0.7)	56 (38.9)	87 (60.4)
SD: Strongly Disagree; D: Disagree; N: Neutral; A: Agree; SA: Strongly Agree					

Table 5: Community pharmacists' practices regarding antibiotic resistance and AMS.

Variable	Responses				
	Never (%)	Rarely (%)	Occasionally (%)	Often (%)	Always (%)
I dispense antibiotics on prescriptions with complete clinical information.	00 (0.0)	2 (1.4)	00 (0.0)	99 (68.7)	43 (29.9)
I dispense antibiotics for durations longer than prescribed by the physician on patient request.	47 (32.6)	45 (31.3)	41 (28.5)	10 (6.9)	1 (0.7)
I screen antibiotic prescriptions following local guidelines before dispensing.	00 (0.0)	3 (2.1)	7 (4.9)	51 (35.4)	83 (57.6)
I collaborate with other health professionals on infection control and antimicrobial stewardship.	7 (4.9)	47 (32.6)	43 (29.9)	31 (21.5)	16 (11.1)
I take part in antimicrobial-awareness campaigns to promote the optimal use of antimicrobials.	8 (5.6)	71 (49.3)	36 (25.0)	18 (12.5)	11 (7.6)
I educate patients on the use of antibiotics and resistance-related issues.	00 (0.0)	56 (38.9)	31 (21.5)	23 (16.0)	34 (23.6)
I dispense antibiotics without a prescription	00 (0.0)	6 (4.2)	18 (12.5)	112 (77.8)	8 (5.5)

Table 6: Relationship between sociodemographic characteristics and knowledge, attitude, and practice of the community pharmacists.

Variable	Knowledge	Attitude	Practices
Age	0.064	0.015	0.005
Sex	0.823	0.397	0.118
Education Level	0.612	0.854	0.742
Work Experience	< 0.001	0.199	0.002
Fisher's exact test.			

with their work experience while attitude was associated with their age. The CPs' practices regarding AMR and AMS were related to their age and work experience.

DISCUSSION

We assessed the knowledge, attitude, and practice of Community Pharmacists (CPs) on antibiotic resistance and antimicrobial stewardship. Currently, there is limited

information about the knowledge, attitude, and practice of CPs on antibiotic resistance and AMS in Zambia.

Community pharmacists' knowledge of antibiotic resistance

Our study found that 93.8% of CPs had good knowledge of antibiotic resistance that was related to their work experience. Similar results were reported in other studies [33,48-53]. The similarities concerning knowledge about antibiotic resistance may be attributed to the adequate knowledge on antibiotics that pharmacists acquire during their university training and practice. Unfortunately, the implementation of good knowledge may be very poor [53]. In Thailand, different results were reported which showed that most pharmacists had inadequate knowledge [54]. Good knowledge of antibiotic use and resistance prevents community pharmacists from irrational dispensing of antibiotics, and this is progressive in the fight against antibiotic resistance [55]. On the other hand, insufficient knowledge results in CPs dispensing antibiotics irrationally thereby exacerbating antibiotic resistance [56,57].

In our study, the majority of the CPs strongly agreed that antibiotic resistance occurs when antibiotics fail to treat bacterial infections and that it usually occurs when there is overuse and misuse of antibiotics. Another study reported similar findings [47]. Many bacterial infections cannot be treated because of the misuse and overuse of antibiotics [58-63]. Antibiotic consumption has been linked to antibiotic resistance [64-67]. Therefore, CPs must help in the appropriate use of antibiotics to reduce the emergence of antibiotic-resistant bacteria. In addition, all healthcare systems must develop initiatives and solutions to reduce antibiotic consumption and antimicrobial resistance [68,69].

The majority of the CPs in our study strongly agreed that antibiotic resistance is a public health problem in our communities. Similar findings were reported in Egypt [70]. Antibiotic resistance is a public health problem that will lead to increased morbidity and mortality if not controlled [64]. In the current study, the majority of the CPs strongly agreed that resistant bacteria can spread from one person to another and this makes infections difficult to treat. The World Health Organization (WHO) reported that resistant bacteria do spread from one person to another and infections caused by resistant bacteria are very difficult to treat [71]. We need to combat antibiotic-resistant bacterial infections and reduce morbidity and mortality associated with antimicrobial resistance [72].

Attitudes of community pharmacists towards antibiotic resistance

Our study found that 67.4% of the CPs had a positive attitude towards antibiotic resistance that was related to their age. Our findings are encouraging because the

positive attitude of CPs may influence them not to dispense antibiotics without a prescription [73]. In Syria, the majority of CPs had a negative attitude towards antibiotic use and resistance [74]. The negative attitude influences CPs to dispense antibiotics without a prescription [59].

In the present study, the majority of the pharmacists agreed that antibiotic resistance is a serious public health problem. Similar results were reported in other studies [59,75]. The majority of the community pharmacists in our study agreed that the appropriate use of antibiotics can reduce problems of antibiotic resistance. Appropriate use of antibiotics will help reduce the threat of antibiotic resistance [76]. It is therefore important that community pharmacists act as antibiotic stewards in the promotion of rational use and prescribing of antibiotics. Community pharmacists are supposed to promote the rational, economic prescribing and appropriate use of medicines as a means of good pharmacy practice [77]. Our findings show that the majority of the pharmacists agreed that adequate training, workshops, and other relevant activities on antibiotic resistance are recommended [78]. Relevant training for community pharmacists can help promote the rational use of antibiotics and thus help to curb antimicrobial resistance. Our study reported that community pharmacists working in collaboration with other healthcare providers must take prominent roles in infection control and antimicrobial stewardship programs. Therefore, the majority of our participants reported that they collaborated with other healthcare workers in infection control and antimicrobial stewardship programs. Other researchers also reported the same findings and concluded that collaboration among healthcare workers improves the rational use and prescribing of antibiotics [33,79,80].

Practices community pharmacists towards antibiotic resistance and AMS

Our study revealed that the majority (75.7%) of CPs had poor practices regarding antibiotic resistance and AMS. The younger and less experienced CPs showed poorer practices compared to the older and experienced CPs. In Pakistan, similar results were reported [33]. Poor practice towards antibiotic resistance calls for quick educational intervention programmes among CPs [81]. Their practice could be affected by a lack of continuing education and other external factors.

Our study highlighted that the majority (68.8%) of the CPs often dispensed antibiotics on prescriptions with complete clinical information. Similar findings were reported in Albania and Tanzania respectively [82,83]. CPs must ensure that they dispense antibiotics on prescriptions with full clinical information and counsel patients on how to use antibiotics [84]. Lack of providing full clinical information and counselling patients on antibiotic use may lead to the escalation of antibiotic resistance.

The majority of the CPs in our study never dispensed antibiotics for durations longer than prescribed by the prescriber or on patient request. Antibiotics should not be dispensed for prolonged durations because this practice can lead to abuse and misuse, which could result in antibiotic resistance [85]. The present study showed that most CPs always screen antibiotic prescriptions following the local guidelines before dispensing. CPs need to ensure that they validate and interpret the prescription correctly based on the recommended guidelines. This promotes the dispensing of appropriate medicines to the right patient [86,87].

Our study revealed that the majority of the CPs rarely collaborated with other healthcare workers in infection control and ASPs. Hayat and colleagues reported similar findings [88]. This could be because most countries do not have well-defined ASPs for community pharmacy practice [33]. All countries are encouraged to start and steer successful ASPs [89]. In Ethiopia, Erku [80] reported that the majority of the community pharmacists collaborated with other healthcare workers in infection control and ASPs. Collaboration between pharmacists and physicians helps to reduce antibiotic resistance [90,91]. The collaboration by pharmacists and physicians also helps pharmacists intervene in certain inappropriately prescribed antibiotics thus helping to reduce antibiotic resistance [92]. Also, pharmacists must unite in the fight against antibiotic resistance [93]. CPs must be encouraged to participate in ASPs because they play a vital role in regulating the use of antibiotics [94-96].

The majority of the CPs in our study rarely participated in antibiotic-awareness campaigns that promote the optimal use of antibiotics. Other studies found similar results [33,97,98]. As a result of this, the majority of the CPs rarely educated patients on the use of antibiotics and resistance-related issues. In contrast, a study in China reported that CPs usually educate patients on antibiotics and antibiotic resistance [99]. Patient education is very important in the provision of community pharmaceutical services and helps reduce infections caused by antibiotic-resistant bacteria [86,100,101].

All the CPs in our study revealed that they dispensed antibiotics without a prescription. Antibiotics, just like other prescription-only drugs, must be dispensed on prescription only [102]. Dispensing antibiotics without prescription is very common in most countries in the world [83, 103-107]. This practice contributes greatly to the emergence of antibiotic-resistant bacteria [108-114]. In Zambia, it is a common practice of selling and dispensing of antibiotics without a prescription [115]. This practice may escalate antibiotic resistance and thus requires urgent interventions. Therefore, pharmacists must continue playing the role of gatekeepers of antibiotics [116]. Educational interventions must be put in place to improve the appropriate prescribing and dispensing of antibiotics [117-119].

Implications for future policy and practice

Concerning policy implications for this research study, antimicrobial stewardship programmes aimed at reducing Antimicrobial Resistance (AMR) need to be promoted in a multi-disciplinary approach. In Zambia, the National Action Plan (NAP) on AMR was developed to address this gap through the One Health approach [120]. Currently, the status of AMR in Zambia is mainly focused on knowledge strengthening as well as evidence obtained from surveillance and research activities. Further training of community pharmacists in Zambia should involve bridging the gap between knowledge and practice. Substantial effort need to be directed towards motivating CPs in undertaking the job of antimicrobial training through continuing education programmes such as Continuous Pharmacy/Medical Education (CPE/CME) workshops [121]. This will be helpful as there is evidence that most pharmacists have not undertaken Antimicrobial Stewardship (AMS) training in Zambia [122]. The government of the Republic of Zambia, other stakeholders, and cooperating partners need to institute inclusive policies for both private and public training institutions that will enable revision of training curriculum content on antimicrobial resistance which may subsequently contribute to reducing AMR. The further focus should be directed to private hospitals and clinics which are easily accessible to members of the public and might be the likely target in implementing AMS programmes. With this research submission, it is recommended that every state must inculcate a rationalised antibiotic usage policy into their national health policies to avoid any serious complications and outcomes in future. It should also be recommended that the prescription and usage of antibiotics must be based on proof but not empirical applications.

Limitations of the study

We acknowledge that the current study has some limitations. It focused on assessing the knowledge, attitude, and practices of community pharmacists leaving out pharmacy technologists who work under the supervision of the pharmacists. Therefore, the results should be interpreted in the context of community pharmacists. The study was done in Lusaka province only; the results could not show the practice, knowledge, and attitude of community pharmacists working in further provinces of Zambia. Since we did not include community pharmacists from all the ten provinces of Zambia, and so, generalization of the results should be done with caution. In addition, self-governed forms used in this research are disposed to common interest unfairness.

The study only focussed on registered community pharmacists and this could create a bias on the findings as illegal drug outlets are a nuisance in the country and could be the important drivers of antibiotic resistance and hamper the efforts towards AMS activities. In any case, this study has provided the much-needed baseline information for

future research work as far as antimicrobial resistance to community pharmacists is concerned.

CONCLUSION

Community pharmacists in Lusaka Zambia had good knowledge and attitude but poor practices regarding antibiotic resistance. There is a need to promote ASPs in community pharmacies that may lead to the improved practice of community pharmacists with regards to antibiotic use, resistance, and AMS. Community pharmacists must be recognized as key players in the control and prevention of infections among community members. Since most community pharmacists dispensed antibiotics without a prescription, this should be highlighted as a major policy issue on AMR and should be addressed by the Government. Therefore, educational intervention programmes with regards to antibiotic use, resistance, and AMS should be periodically focussed on community pharmacy practice.

ACKNOWLEDGEMENTS

We would like to acknowledge the owners of the community pharmacies and the pharmacists for cooperating with us during data collection from their premises. We are grateful to the University of Zambia Library for providing access to many articles that were used for reference in this manuscript.

ETHICAL APPROVAL

The study was approved by the University of Zambia Health Sciences Research Ethics Committee (UNZAHSREC), protocol ID: 20190217024, IORG no: 0009227, IRB no: 00011000. All participants provided consent by reading and signing the consent form before responding to the questionnaire.

References

- Conly J, Johnston B. Where are all the new antibiotics? The new antibiotic paradox. *Can J Infect Dis Med Microbiol*. 2005 May;16(3):159-60. doi: 10.1155/2005/892058. PMID: 18159536; PMCID: PMC2095020.
- Gottlieb T, Nimmo GR. Antibiotic resistance is an emerging threat to public health: an urgent call to action at the Antimicrobial Resistance Summit 2011. *Med J Aust*. 2011 Mar 21;194(6):281-3. doi: 10.5694/j.1326-5377.2011.tb02973.x. PMID: 21426279.
- Collignon PJ, McEwen SA. One Health-Its Importance in Helping to Better Control Antimicrobial Resistance. *Trop Med Infect Dis*. 2019 Jan 29;4(1):22. doi: 10.3390/tropicalmed4010022. PMID: 30700019; PMCID: PMC6473376.
- Jinks T, Lee N, Sharland M, Rex J, Gertler N, Diver M, Jones I, Jones K, Mathewson S, Chiara F, Farrar J. A time for action: antimicrobial resistance needs global response. *Bull World Health Organ*. 2016 Aug 1;94(8):558-558A. doi: 10.2471/BLT.16.181743. PMID: 27516629; PMCID: PMC4969997.
- Friedman ND, Temkin E, Carmeli Y. The negative impact of antibiotic resistance. *Clin Microbiol Infect*. 2016 May;22(5):416-22. doi: 10.1016/j.cmi.2015.12.002. Epub 2015 Dec 17. PMID: 26706614.
- Sabtu N, Enoch DA, Brown NM. Antibiotic resistance: what, why, where, when and how? *Br Med Bull*. 2015;116:105-13. doi: 10.1093/bmb/ldv041. Epub 2015 Oct 21. PMID: 26491083.
- Franco BE, Altgracia Martínez M, Sánchez Rodríguez MA, Wertheimer AI. The determinants of the antibiotic resistance process. *Infect Drug Resist*. 2009;2:1-11. Epub 2009 Apr 17. PMID: 21694883; PMCID: PMC3108730.
- Saleem Z, Saeed H, Ahmad M, Yousaf M, Hassan HB, Javed A, Anees N, Maharjan S. Antibiotic Self-Prescribing Trends, Experiences and Attitudes in Upper Respiratory Tract Infection among Pharmacy and Non-Pharmacy Students: A Study from Lahore. *PLoS One*. 2016 Feb 26;11(2):e0149929. doi: 10.1371/journal.pone.0149929. PMID: 26919465; PMCID: PMC4769098.
- Kotwani A, Holloway K. Antibiotic prescribing practice for acute, uncomplicated respiratory tract infections in primary care settings in New Delhi, India. *Trop Med Int Health*. 2014 Jul;19(7):761-8. doi: 10.1111/tmi.12327. Epub 2014 Apr 22. PMID: 24750565.
- Tyrstrup M, Melander E, Hedin K, Beckman A, Mölstad S. Children with respiratory tract infections in Swedish primary care; prevalence of antibiotic resistance in common respiratory tract pathogens and relation to antibiotic consumption. *BMC Infect Dis*. 2017 Sep 4;17(1):603. doi: 10.1186/s12879-017-2703-3. PMID: 28870173; PMCID: PMC5583975.
- Hsu J. How covid-19 is accelerating the threat of antimicrobial resistance. *BMJ*. 2020 May 18;369:m1983. doi: 10.1136/bmj.m1983. PMID: 32423901.
- Mudenda S. Letter to Editor: Coronavirus Disease (COVID-19): A Global Health Problem. *Int J Pharm Pharmacol*. 2020;4(1):141.
- Reardon S. Antibiotic treatment for covid-19 complications could fuel resistant bacteria. *Science* 2020. <https://bit.ly/3nxCmvg>
- Phiri MN, Banda M, Mudenda S, Ngazimbi M, Hangoma J, Mufwambi W et al. Coronavirus Disease 2019 (COVID-19): the role of pharmacists in the Fight against COVID-19 Pandemic. *Int J Pharm Pharmacol*. 2020;4(1):143.
- Godman B, Haque M, McKimm J, Abu Bakar M, Sneddon J, Wale J, Campbell S, Martin AP, Hoxha I, Abilova V, Anand Paramadhas BD, Mpinda-Joseph P, Matome M, de Lemos LLP, Sefah I, Kurdi A, Opanga S, Jakupi A, Saleem Z, Hassali MA, Kibuule D, Fadare J, Bochenek T, Rothe C, Furst J, Markovic-Pekovic V, Bojanić L, Schellack N, Meyer JC, Matsebula Z, Phuong TNT, Thanh BN, Jan S, Kalungia A, Mtapuri-Zinyowera S, Sartelli M, Hill R. Ongoing strategies to improve the management of upper respiratory tract infections and reduce inappropriate antibiotic use particularly among lower and middle-income countries: findings and implications for the future. *Curr Med Res Opin*. 2020 Feb;36(2):301-327. doi: 10.1080/03007995.2019.1700947. Epub 2019 Dec 30. PMID: 31794332.
- Adepu R, Nagavi BG. General practitioner's perceptions about the extended roles of the community pharmacist in the state of Karnataka: A study. *Indian J Pharm Sci*. 2006;68(1):36-40. doi: 10.4103/0250-474X.22961
- Ahmad A, Atique S, Balkrishnan R, Patel I. Pharmacy profession in India: Current scenario and Recommendations. *Ind J Pharm Edu Res*. 2014;48:12-15. <https://bit.ly/3vTAbpQ>
- Sharma H, Jindal D, Aqil M, Alam M, Karim S, Kapur P. A survey for assessment of the role of the pharmacist in community pharmacy services. *J. Pharm. Bioallied Sci*. 2009;1:23. <https://bit.ly/3CqbW5d>
- Hoa NB, Tiemersma EW, Sy DN, Nhung NV, Vree M, Borgdorff MW, Cobelens FG. Health-seeking behaviour among adults with prolonged cough in Vietnam. *Trop Med Int Health*. 2011 Oct;16(10):1260-7. doi: 10.1111/j.1365-3156.2011.02823.x. Epub 2011 Jun 22. PMID: 21692960.
- Yegenoglu S, Ozelikay G. Counseling of pharmacists to community on issues other than drug purchasing and drug-related information: a survey in Ankara. *Turkish J Pharm Sci*. 2005;2(2):83-91. <https://bit.ly/3EqW6bc>
- Rutter P. Role of community pharmacists in patients' self-care and self-medication. *Integr Pharm Res Pract*. 2015 Jun 24;4:57-65. doi: 10.2147/IPRP.S70403. PMID: 29354520; PMCID: PMC5741028.
- Awad AI, Aboud EA. Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. *PLoS One*. 2015 Feb 12;10(2):e0117910. doi: 10.1371/journal.pone.0117910. PMID: 25675405; PMCID: PMC4326422.
- Saleem Z, Hassali MA, Godman B, Fatima M, Ahmad Z, Sajid A, Rehman IU, Nadeem MU, Javaid Z, Malik M, Hussain A. Sale of WHO AWaRe groups antibiotics without a prescription in Pakistan: a simulated client study. *J Pharm Policy Pract*. 2020 Aug 3;13:26. doi: 10.1186/s40545-020-00233-3. PMID: 32774870; PMCID: PMC7397594.
- Marković-Peković V, Grubiša N. Self-medication with antibiotics in the Republic of Srpska community pharmacies: pharmacy staff behavior. *Pharmacoepidemiol Drug Saf*. 2012 Oct;21(10):1130-3. doi: 10.1002/pds.3218. Epub 2012 Feb 15. PMID: 22334375.
- Sadasivam K, Chinnasami B, Ramraj B, Karthick N, Saravanan A. Knowledge, Attitude and Practice of Paramedical staff towards antibiotic usage and its resistance. *Integerrima Barberry. Biomed Pharmacol J*. 2016;9(1):337-343. doi: 10.13005/bpj/944
- Morgan DJ, Okeke IN, Laxminarayan R, Perencevich EN, Weisenberg S. Non-prescription antimicrobial use worldwide: a systematic review. *Lancet Infect Dis*. 2011 Sep;11(9):692-701. doi: 10.1016/S1473-3099(11)70054-8. Epub 2011 Jun 12. PMID: 21659004; PMCID: PMC3543997.

27. Al-Faham Z, Habboub G, Takriti F. The sale of antibiotics without prescription in pharmacies in Damascus, Syria. *J Infect Dev Ctries*. 2011 May 28;5(5):396-9. doi: 10.3855/jidc.1248. PMID: 21628818.
28. Alalbid AH, Ibrahim MI, Hassali MA. Antibiotics Dispensing for URTIs by Community Pharmacists (CPs) and General Medical Practitioners in Penang, Malaysia: A Comparative Study using Simulated Patients (SPs). *J Clin Diagn Res*. 2014 Jan;8(1):119-23. doi: 10.7860/JCDR/2014/6199.3923. Epub 2014 Jan 12. PMID: 24596741; PMCID: PMC3939520.
29. Saleem Z, Hassali MA, Hashmi FK. Pakistan's national action plan for antimicrobial resistance: translating ideas into reality. *Lancet Infect Dis*. 2018 Oct;18(10):1066-1067. doi: 10.1016/S1473-3099(18)30516-4. PMID: 30303099.
30. Waseem H, Ali J, Sarwar F, Khan A, Rehman HSU, Choudhri M, Arif N, Subhan M, Saleem AR, Jamal A, Ali MI. Assessment of knowledge and attitude trends towards antimicrobial resistance (AMR) among the community members, pharmacists/pharmacy owners and physicians in district Sialkot, Pakistan. *Antimicrob Resist Infect Control*. 2019 Apr 24;8:67. doi: 10.1186/s13756-019-0517-3. PMID: 31049196; PMCID: PMC6482541.
31. Melton BL, Lai Z. Review of community pharmacy services: what is being performed, and where are the opportunities for improvement? *Integr Pharm Res Pract*. 2017 Mar 6;6:79-89. doi: 10.2147/IPRP.S107612. PMID: 29354554; PMCID: PMC5774328.
32. Chuc NT, Larsson M, Do NT, Diwan VK, Tomson GB, Falkenberg T. Improving private pharmacy practice: a multi-intervention experiment in Hanoi, Vietnam. *J Clin Epidemiol*. 2002 Nov;55(11):1148-55. doi: 10.1016/S0895-4356(02)00458-4. PMID: 12507680.
33. Sarwar MR, Saqib A, Iftikhar S, Sadiq T. Knowledge of community pharmacists about antibiotics, and their perceptions and practices regarding antimicrobial stewardship: a cross-sectional study in Punjab, Pakistan. *Infect Drug Resist*. 2018 Jan 18;11:133-145. doi: 10.2147/IDR.S148102. PMID: 29403295; PMCID: PMC5783150.
34. Saleem Z, Hassali MA, Hashmi FK, Godman B, Saleem F. Antimicrobial dispensing practices and determinants of antimicrobial resistance: a qualitative study among community pharmacists in Pakistan. *Fam Med Community Health*. 2019 Jul 12;7(3):e000138. doi: 10.1136/fmch-2019-000138. PMID: 32148717; PMCID: PMC6910752.
35. Barlam TF, Cosgrove SE, Abbo LM, MacDougall C, Schuetz AN, Septimus EJ, Srinivasan A, Dellit TH, Falck-Ytter YT, Fishman NO, Hamilton CW, Jenkins TC, Lipsett PA, Malani PN, May LS, Moran GJ, Neuhauser MM, Newland JG, Ohl CA, Samore MH, Seo SK, Trivedi KK. 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 May 15;62(10):e51-77. doi: 10.1093/cid/ciw118. Epub 2016 Apr 13. PMID: 27080992; PMCID: PMC5006285.
36. Gilchrist M, Wade P, Ashiru-Oredope D, Howard P, Sneddon J, Whitney L, Wickens H. Antimicrobial Stewardship from Policy to Practice: Experiences from UK Antimicrobial Pharmacists. *Infect Dis Ther*. 2015 Sep;4(Suppl 1):51-64. doi: 10.1007/s40121-015-0080-z. Epub 2015 Sep 11. PMID: 26362295; PMCID: PMC4569645.
37. Erku DA, Abera SY. Non-prescribed sale of antibiotics for acute childhood diarrhea and upper respiratory tract infection in community pharmacies: a 2 phase mixed-methods study. *Antimicrob Resist Infect Control*. 2018 Jul 31;7:92. doi: 10.1186/s13756-018-0389-y. Erratum in: *Antimicrob Resist Infect Control*. 2019 Jan 11;8:10. PMID: 30079248; PMCID: PMC6069571.
38. Bishop C, Yacoob Z, Knobloch MJ, Safdar N. Community pharmacy interventions to improve antibiotic stewardship and implications for pharmacy education: A narrative overview. *Res Social Adm Pharm*. 2019 Jun;15(6):627-631. doi: 10.1016/j.sapharm.2018.09.017. Epub 2018 Sep 26. PMID: 30279131.
39. Essack S, Bell J, Shephard A. Community pharmacists-Leaders for antibiotic stewardship in respiratory tract infection. *J Clin Pharm Ther*. 2018 Apr;43(2):302-307. doi: 10.1111/jcpt.12650. Epub 2017 Dec 4. PMID: 29205419.
40. Brink AJ, Messina AP, Feldman C, Richards GA, Becker PJ, Goff DA, Bauer KA, Nathwani D, van den Bergh D; Netcare Antimicrobial Stewardship Study Alliance. Antimicrobial stewardship across 47 South African hospitals: an implementation study. *Lancet Infect Dis*. 2016 Sep;16(9):1017-1025. doi: 10.1016/S1473-3099(16)30012-3. Epub 2016 Jun 14. PMID: 27312577.
41. Saha SK, Barton C, Promite S, Mazza D. Knowledge, Perceptions and Practices of Community Pharmacists Towards Antimicrobial Stewardship: A Systematic Scoping Review. *Antibiotics (Basel)*. 2019 Dec 12;8(4):263. doi: 10.3390/antibiotics8040263. PMID: 31842511; PMCID: PMC6963969.
42. Spellberg B, Guidos R, Gilbert D, Bradley J, Boucher HW, Scheld WM, Bartlett JG, Edwards J Jr; Infectious Diseases Society of America. The epidemic of antibiotic-resistant infections: a call to action for the medical community from the Infectious Diseases Society of America. *Clin Infect Dis*. 2008 Jan 15;46(2):155-64. doi: 10.1086/524891. PMID: 18171244.
43. Atif M, Asghar S, Mushtaq I, Malik I. Community pharmacists as antibiotic stewards: A qualitative study exploring the current status of Antibiotic Stewardship Program in Bahawalpur, Pakistan. *J Infect Public Health*. 2020 Jan;13(1):118-124. doi: 10.1016/j.jiph.2019.07.003. Epub 2019 Sep 20. PMID: 31548165.
44. Avent ML, Fejic J, van Driel ML. An underutilised resource for Antimicrobial Stewardship: a 'snapshot' of the community pharmacists' role in delayed or 'wait and see' antibiotic prescribing. *Int J Pharm Pract*. 2018 Aug;26(4):373-375. doi: 10.1111/ijpp.12431. Epub 2018 Jan 10. PMID: 29318696.
45. Zambia Medicines Regulatory Authority (ZAMRA). 2019.
46. Guilford JP, Fruchter B. Fundamental statistics in psychology and education. New York: McGraw-Hill; 1973. <https://bit.ly/2XTVL0U>
47. Mudenda S, Bangara FF, Sitali J, Banda M. Knowledge, attitude, and practices on antibiotic resistance among Pharmacists at the University Teaching hospitals in Lusaka, Zambia. *Journal of Harmonized Research in Pharmacy*. 2019;8:12-24. <https://bit.ly/3EpLjH>
48. Gebretekle GB, Serbessa MK. Exploration of over the counter sales of antibiotics in community pharmacies of Addis Ababa, Ethiopia: pharmacy professionals' perspective. *Antimicrob Resist Infect Control*. 2016 Jan 29;5:2. doi: 10.1186/s13756-016-0101-z. PMID: 26835006; PMCID: PMC4734870.
49. Saengcharoen W, Chongsuvivatwong V, Lerkiatbundit S, Wongpoowarak P. Factors influencing dispensing of antibiotics for upper respiratory infections among Southern Thai community pharmacists. *J Clin Pharm Ther*. 2008 Apr;33(2):123-9. doi: 10.1111/j.1365-2710.2007.00890.x. PMID: 18315777.
50. Zawahir S, Lekamwasam S, Aslani P. A cross-sectional national survey of community pharmacy staff: Knowledge and antibiotic provision. *PLoS One*. 2019 Apr 25;14(4):e0215484. doi: 10.1371/journal.pone.0215484. PMID: 31022197; PMCID: PMC6483176.
51. Dillip A, Embrey M, Shekalaghe E, Ross-Degnan D, Vialle-Valentin C, Kimatta S, Liana J, Rutta E, Valimba R, Chalker J. What motivates antibiotic dispensing in accredited drug dispensing outlets in Tanzania? A qualitative study. *Antimicrob Resist Infect Control*. 2015 Jul 21;4:30. doi: 10.1186/s13756-015-0073-4. PMID: 26199723; PMCID: PMC4509560.
52. Zakaa El-Din M, Samy F, Mohamed A, Hamdy F, Yasser S, Ehab M. Egyptian community pharmacists' attitudes and practices towards antibiotic dispensing and antibiotic resistance; a cross-sectional survey in Greater Cairo. *Curr Med Res Opin*. 2019 Jun;35(6):939-946. doi: 10.1080/03007995.2018.1544119. Epub 2018 Dec 4. PMID: 30388895.
53. Jamshed S, Padzil F, Shamsudin SH, Bux SH, Jamaluddin AA, Bhagavathula AS, Azhar S, Hassali MA. Antibiotic Stewardship in Community Pharmacies: A Scoping Review. *Pharmacy (Basel)*. 2018 Aug 23;6(3):92. doi: 10.3390/pharmacy6030092. PMID: 30142902; PMCID: PMC6163858.
54. Apisarnthanarak A, Tunpornchai J, Tanawitt K, Mundy LM. Nonjudicious dispensing of antibiotics by drug stores in Pratumthani, Thailand. *Infect Control Hosp Epidemiol*. 2008 Jun;29(6):572-5. doi: 10.1086/587496. PMID: 18510468.
55. Muñoz EB, Dorado MF, Guerrero JE, Martínez FM. The effect of an educational intervention to improve patient antibiotic adherence during dispensing in a community pharmacy. *Aten Primaria*. 2014 Aug-Sep;46(7):367-75. doi: 10.1016/j.aprim.2013.12.003. Epub 2014 Feb 26. PMID: 24581680; PMCID: PMC6983631.
56. Ghiga I, Stålsby Lundborg C. 'Struggling to be a defender of health' - a qualitative study on the pharmacists' perceptions of their role in antibiotic consumption and antibiotic resistance in Romania. *J Pharm Policy Pract*. 2016 Mar 31;9:10. doi: 10.1186/s40545-016-0061-y. PMID: 27042313; PMCID: PMC4818418.
57. Zapata-Cachafeiro M, González-González C, Vázquez-Lago JM, López-Vázquez P, López-Durán A, Smyth E, Figueiras A. Determinants of antibiotic dispensing without a medical prescription: A cross-sectional study in the north of Spain. *J Antimicrob Chemother*. 2014; 69:3156-3160.
58. Ventola CL. The antibiotic resistance crisis: part 1: causes and threats. *P T*. 2015 Apr;40(4):277-83. PMID: 25859123; PMCID: PMC4378521.
59. Roque F, Soares S, Breitenfeld L, Figueiras A, Herdeiro MT. Influence of community pharmacists' attitudes on antibiotic dispensing behavior: a cross-sectional study in Portugal. *Clin Ther*. 2015 Jan 1;37(1):168-77. doi: 10.1016/j.clinthera.2014.11.006. Epub 2014 Dec 4. PMID: 25482306.
60. Dooling KL, Kandeel A, Hicks LA, El-Shoubary W, Fawzi K, Kandeel Y, Etman A, Lohiniva AL, Talaat M. Understanding Antibiotic Use in Minya District, Egypt: Physician and Pharmacist Prescribing and the Factors Influencing Their Practices. *Antibiotics (Basel)*. 2014 Jun 20;3(2):233-43. doi: 10.3390/antibiotics3020233. PMID: 27025746; PMCID: PMC4790392.
61. Al-Azzam SI, Al-Husein BA, Alzoubi F, Masadeh MM, Al-Horani MA. Self-medication with antibiotics in Jordanian population. *Int J Occup Med Environ Health*. 2007;20(4):373-80. doi: 10.2478/v10001-007-0038-9. PMID: 18165197.

62. Ameko E, Achio S, Alhassan S. Effects of Antibiotic Self-Medication on the Efficacy of Four Antibiotics Commonly used in Ghana on Clinically Isolated Microorganisms. *Int J Pure Appl Sci Technol*. 2012;10:62-70.
63. Haddadin RN, Alsous M, Wazaifi M, Tahaineh L. Evaluation of antibiotic dispensing practice in community pharmacies in Jordan: A cross sectional study. *PLoS One*. 2019 Apr 29;14(4):e0216115. doi: 10.1371/journal.pone.0216115. PMID: 31034528; PMCID: PMC6488076.
64. O'Neill J. The Review on Antimicrobial Resistance. Tackling Drug-Resistant Infections Globally: Final Report and Recommendations. 2016. <https://bit.ly/2ZvHnvw>
65. Goossens H. Antibiotic consumption and link to resistance. *Clin Microbiol Infect*. 2009 Apr;15 Suppl 3:12-5. doi: 10.1111/j.1469-0691.2009.02725.x. PMID: 19366364.
66. Wojkowska-Mach J, Godman B, Glassman A, Kurdi A, Pilc A, Rozanska A, Skoczyński S, Wałaszek M, Bochenek T. Antibiotic consumption and antimicrobial resistance in Poland; findings and implications. *Antimicrob Resist Infect Control*. 2018 Nov 15;7:136. doi: 10.1186/s13756-018-0428-8. PMID: 30473786; PMCID: PMC6238284.
67. Kardas P, Devine S, Golembesky A, Roberts C. A systematic review and meta-analysis of misuse of antibiotic therapies in the community. *Int J Antimicrob Agents*. 2005 Aug;26(2):106-13. doi: 10.1016/j.ijantimicag.2005.04.017. PMID: 16009535.
68. Godman B, Fadare J, Kibuule D, et al. Initiatives across countries to reduce antibiotic utilisation and resistance patterns: impact and implications. In: Arora G, Sajid A, Kalia VC, editors. *Drug resistance in bacteria, fungi, malaria, and cancer*. Cham: Springer International Publishing; 2017. p.539-576. <https://bit.ly/3BpP1Wg>
69. Laxminarayan R, Duse A, Wattal C, Zaidi AK, Wertheim HF, Sumpradit N, Vlieghe E, Hara GL, Gould IM, Goossens H, Greko C, So AD, Bigdeli M, Tomson G, Woodhouse W, Ombaka E, Peralta AQ, Qamar FN, Mir F, Kariuki S, Bhutta ZA, Coates A, Bergstrom R, Wright GD, Brown ED, Cars O. Antibiotic resistance-the need for global solutions. *Lancet Infect Dis*. 2013 Dec;13(12):1057-98. doi: 10.1016/S1473-3099(13)70318-9. Epub 2013 Nov 17. Erratum in: *Lancet Infect Dis*. 2014 Jan;14(1):11. Erratum in: *Lancet Infect Dis*. 2014 Mar;14(3):182. PMID: 24252483.
70. Abdelaziz AI, Tawfik AG, Rabie KA, Omran M, Hussein M, Abou-Ali A, Ahmed AF. Quality of Community Pharmacy Practice in Antibiotic Self-Medication Encounters: A Simulated Patient Study in Upper Egypt. *Antibiotics (Basel)*. 2019 Apr 1;8(2):35. doi: 10.3390/antibiotics8020035. PMID: 30939797; PMCID: PMC6627069.
71. World Health Organisation (WHO). Factsheet: Antimicrobial resistance. 2017.
72. Leung E, Weil DE, Raviglione M, Nakatani H; World Health Organization World Health Day Antimicrobial Resistance Technical Working Group. The WHO policy package to combat antimicrobial resistance. *Bull World Health Organ*. 2011 May 1;89(5):390-2. doi: 10.2471/BLT.11.088435. PMID: 21556308; PMCID: PMC3089396.
73. Roque F, Soares S, Breitenfeld L, López-Durán A, Figueiras A, Herdeiro MT. Attitudes of community pharmacists to antibiotic dispensing and microbial resistance: a qualitative study in Portugal. *Int J Clin Pharm*. 2013 Jun;35(3):417-24. doi: 10.1007/s11096-013-9753-4. Epub 2013 Feb 9. PMID: 23397322.
74. Mansour O, Al-Kayali R. Community Pharmacists' Role in Controlling Bacterial Antibiotic Resistance in Aleppo, Syria. *Iran J Pharm Res*. 2017 Fall;16(4):1612-1620. PMID: 29552070; PMCID: PMC5843323.
75. Gajdács M, Paulik E, Szabó A. Knowledge, Attitude and Practice of Community Pharmacists Regarding Antibiotic Use and Infectious Diseases: A Cross-Sectional Survey in Hungary (KAPPhA-HU). *Antibiotics (Basel)*. 2020 Jan 21;9(2):41. doi: 10.3390/antibiotics9020041. PMID: 31973119; PMCID: PMC7168197.
76. Machowska A, Stålsby Lundborg C. Drivers of Irrational Use of Antibiotics in Europe. *Int J Environ Res Public Health*. 2018 Dec 23;16(1):27. doi: 10.3390/ijerph16010027. PMID: 30583571; PMCID: PMC6338985.
77. Hanafi S, Poormalek F, Torkamandi H, Hajimiri M, Esmaeili M, Khoie S, Gholami K, Hayatshahi A, Javadi M. Evaluation of Community Pharmacists' Knowledge, Attitude and Practice towards Good Pharmacy Practice in Iran. *J Pharm Care*. 2013;1(1):19-24. <https://bit.ly/3vTwlI2>
78. Marković-Peković V, Grubiša N, Burger J, Bojanić L, Godman B. Initiatives to Reduce Nonprescription Sales and Dispensing of Antibiotics: Findings and Implications. *J Res Pharm Pract*. 2017 Apr-Jun;6(2):120-125. doi: 10.4103/jrpp.JRPP_17_12. PMID: 28616436; PMCID: PMC5463547.
79. Hayat K, Rosenthal M, Gillani AH, Chang J, Ji W, Yang C, Jiang M, Zhao M, Fang Y. Perspective of Key Healthcare Professionals on Antimicrobial Resistance and Stewardship Programs: A Multicenter Cross-Sectional Study From Pakistan. *Front Pharmacol*. 2020 Jan 10;10:1520. doi: 10.3389/fphar.2019.01520. PMID: 31998124; PMCID: PMC6967405.
80. Erku DA. Antimicrobial Stewardship: A Cross-Sectional Survey Assessing the Perceptions and Practices of Community Pharmacists in Ethiopia. *Interdiscip Perspect Infect Dis*. 2016;2016:5686752. doi: 10.1155/2016/5686752. Epub 2016 Nov 22. PMID: 27994621; PMCID: PMC5138470.
81. Vazquez-Lago J, Gonzalez-Gonzalez C, Zapata-Cachafeiro M, Lopez-Vazquez P, Taracido M, López A, Figueiras A. Knowledge, attitudes, perceptions and habits towards antibiotics dispensed without medical prescription: a qualitative study of Spanish pharmacists. *BMJ Open*. 2017 Oct 8;7(10):e015674. doi: 10.1136/bmjopen-2016-015674. PMID: 28993379; PMCID: PMC5640063.
82. Hoxha I, Malaj A, Kraja B, Bino S, Oluka M, Marković-Peković V, Godman B. Are pharmacists' good knowledge and awareness on antibiotics taken for granted? The situation in Albania and future implications across countries. *J Glob Antimicrob Resist*. 2018 Jun;13:240-245. doi: 10.1016/j.jgar.2018.01.019. Epub 2018 Feb 4. PMID: 29414723.
83. Horumpende PG, Sonda TB, van Zwetselaar M, Antony ML, Tenu FF, Mwanziva CE, Shao ER, Mshana SE, Mmbaga BT, Chilongola JO. Prescription and non-prescription antibiotic dispensing practices in part I and part II pharmacies in Moshi Municipality, Kilimanjaro Region in Tanzania: A simulated clients approach. *PLoS One*. 2018 Nov 21;13(11):e0207465. doi: 10.1371/journal.pone.0207465. PMID: 30462700; PMCID: PMC6248976.
84. Dameh M, Norris P, Green J. New Zealand pharmacists' experiences, practices and views regarding antibiotic use without prescription. *J Prim Health Care*. 2012 Jun 1;4(2):131-40. PMID: 22675697.
85. Nasrin D, Collignon PJ, Roberts L, Wilson EJ, Pilotto LS, Douglas RM. Effect of beta lactam antibiotic use in children on pneumococcal resistance to penicillin: prospective cohort study. *BMJ*. 2002 Jan 5;324(7328):28-30. doi: 10.1136/bmj.324.7328.28. PMID: 11777803; PMCID: PMC61657.
86. Costa FA, Scullin C, Al-Taani G, Hawwa AF, Anderson C, Bezverhni Z, Binakaj Z, Cordina M, Foulon V, Garcia de Bikuña B, de Gier H, Granäs AG, Grinstova O, Griesse-Mammen N, Grincevicius J, Grinceviciene S, Kae S, Kubiliene L, Marifio EL, Martins S, Modamio P, Nadin G, Nørgaard LS, Obarcanin E, Tadic I, Tasic L, McElroy JC, Hersberger KE, Westerlund T. Provision of pharmaceutical care by community pharmacists across Europe: Is it developing and spreading? *J Eval Clin Pract*. 2017 Dec;23(6):1336-1347. doi: 10.1111/jep.12783. Epub 2017 Aug 1. PMID: 28762651.
87. Kennie-Kaulbach N, Farrell B, Ward N, Johnston S, Gubbels A, Equale T, Dolovich L, Jorgenson D, Waite N, Winslade N. Pharmacist provision of primary health care: a modified Delphi validation of pharmacists' competencies. *BMC Fam Pract*. 2012 Mar 28;13:27. doi: 10.1186/1471-2296-13-27. PMID: 22455482; PMCID: PMC3372430.
88. Hayat K, Li P, Rosenthal M, Xu S, Chang J, Gillani AH, Khan FU, Sarwar MR, Ji S, Shi L, Cheng A, Fang Y. Perspective of community pharmacists about community-based antimicrobial stewardship programs. A multicenter cross-sectional study from China. *Expert Rev Anti Infect Ther*. 2019 Dec;17(12):1043-1050. doi: 10.1080/14787210.2019.1692655. Epub 2019 Nov 18. PMID: 31714841.
89. Drew RH. Antimicrobial stewardship programs: how to start and steer a successful program. *J Manag Care Pharm*. 2009 Mar;15(2 Suppl):S18-23. doi: 10.18553/jmcp.2009.15.s2.18. PMID: 19236137.
90. Klepser ME, Adams AJ, Klepser DG. Antimicrobial stewardship in outpatient settings: leveraging innovative physician-pharmacist collaborations to reduce antibiotic resistance. *Health Secur*. 2015 May-Jun;13(3):166-73. doi: 10.1089/hs.2014.0083. PMID: 26042860.
91. Tegagn GT, Yadesa TM, Ahmed Y. Knowledge, Attitudes and Practices of Healthcare Professionals towards Antimicrobial Stewardship and Their Predictors in Fitcha Hospital. *J Bioanal Biomed*. 2017;9:091-097. doi: 10.4172/1948-593X.1000159
92. Saha SK, Hawes L, Mazza D. Effectiveness of interventions involving pharmacists on antibiotic prescribing by general practitioners: a systematic review and meta-analysis. *J Antimicrob Chemother*. 2019 May 1;74(5):1173-1181. doi: 10.1093/jac/dky572. PMID: 30698721.
93. Howard P, Ashiru-Oredope D, Gilchrist M. Time for pharmacy to unite in the fight against antimicrobial resistance. *Organ*. 2014;18:08.
94. Schellack N, Bronkhorst E, Coetzee R, Godman B, Gous AGS, Kolman S, Labuschagne Q, Malan L, Messina AP, Naested C, Schellack G, Skosana P, Van Jaarsveld A. SASOCP position statement on the pharmacist's role in antibiotic stewardship 2018. *South African J Infect Dis*. 2018;33(1):28-35. doi: 10.4102/sajid.v33i1.24
95. Brink AJ, Messina AP, Feldman C, Richards GA, Becker PJ, Goff DA, Bauer KA, Nathwani D, van den Bergh D; Netcare Antimicrobial Stewardship Study Alliance. Antimicrobial stewardship across 47 South African hospitals: an implementation study. *Lancet Infect Dis*. 2016 Sep;16(9):1017-1025. doi: 10.1016/S1473-3099(16)30012-3. Epub 2016 Jun 14. PMID: 27312577.
96. Khan MU, Hassali MA, Ahmad A, Elkalimi RM, Zaidi ST, Dhinnga S. Perceptions and Practices of Community Pharmacists towards Antimicrobial Stewardship in the State of Selangor, Malaysia. *PLoS One*. 2016 Feb 22;11(2):e0149623. doi: 10.1371/journal.pone.0149623. PMID: 26901404; PMCID: PMC4764324.
97. Cotta MO, Robertson MS, Tacey M, et al. Attitudes towards antimicrobial stewardship: results from a large private hospital in Australia. *Healthc Infect*. 2014;19(3):89-94. doi: 10.1071/HI14008.

98. PGEU statement Community pharmacists' contribution to the control of antibiotic resistance'. Brussels: Pharmaceutical Group of the European Union. 2009.
99. Fang Y, Yang S, Zhou S, Jiang M, Liu J. Community pharmacy practice in China: past, present and future. *Int J Clin Pharm*. 2013 Aug;35(4):520-8. doi: 10.1007/s11096-013-9789-5. Epub 2013 May 10. PMID: 23661172.
100. Mohanta GP, Manna PK, Valliappan K, Manavalan R. Achieving good pharmacy practice in community pharmacies in India. *Am J Health Syst Pharm*. 2001 May 1;58(9):809-10. doi: 10.1093/ajhp/58.9.809. PMID: 11351923.
101. Rodis JL, Green CG, Cook SC, Pedersen CA. Effects of a pharmacist-initiated educational intervention on patient knowledge about the appropriate use of antibiotics. *Am J Health Syst Pharm*. 2004 Jul 1;61(13):1385-9. doi: 10.1093/ajhp/61.13.1385. PMID: 15287235.
102. Kamba PF, Mulangwa J, Kaggwa B, Kitutu FE, Sewankambo NK, Katabira ET, Byakika-Kibwika P, Adome RO, Bollinger RC. Compliance of private pharmacies in Uganda with controlled prescription drugs regulations: a mixed-methods study. *Subst Abuse Treat Prev Policy*. 2020 Feb 18;15(1):16. doi: 10.1186/s13011-020-00261-x. PMID: 32070374; PMCID: PMC7027211.
103. Bahnassi A. A qualitative analysis of pharmacists' attitudes and practices regarding the sale of antibiotics without prescription in Syria. *J Taibah Univ Med Sci*. 2015;10:227-233. doi: 10.1016/j.jtumed.2014.09.001
104. Zawahir S, Lekamwasam S, Aslani P. Antibiotic dispensing practice in community pharmacies: A simulated client study. *Res Social Adm Pharm*. 2019 May;15(5):584-590. doi: 10.1016/j.sapharm.2018.07.019. Epub 2018 Jul 29. PMID: 30093309.
105. Al-Hamad A. Over-the-counter delivery of antibiotics: are we sending the right message? *Am J Infect Control*. 2012 Feb;40(1):81-2. doi: 10.1016/j.ajic.2011.08.011. Epub 2011 Dec 2. PMID: 22137194.
106. Bahta M, Tesfamariam S, Weldemariam DG, Yemane H, Tesfamariam EH, Alem T, Russom M. Dispensing of antibiotics without prescription and associated factors in drug retail outlets of Eritrea: A simulated client method. *PLoS One*. 2020 Jan 24;15(1):e0228013. doi: 10.1371/journal.pone.0228013. PMID: 31978180; PMCID: PMC6980490.
107. Ansari M. Evaluation of community pharmacies regarding dispensing practices of antibiotics in two districts of central Nepal. *PLoS One*. 2017 Sep 26;12(9):e0183907. doi: 10.1371/journal.pone.0183907. PMID: 28949990; PMCID: PMC5614431.
108. Akinyandenu O, Akinyandenu A. Irrational use and non-prescription sale of antibiotics in Nigeria: a need for change. *J Sci Innovat Res*. 2014;3(2):251-257. <https://bit.ly/3bmGQQ4>
109. Hadi MA, Karami NA, Al-Muwalid AS, Al-Otobi A, Al-Subahi E, Bamomen A, Mohamed MM, Elrgal ME. Community pharmacists' knowledge, attitude, and practices towards dispensing antibiotics without prescription (DAWP): a cross-sectional survey in Makkah Province, Saudi Arabia. *Int J Infect Dis*. 2016 Jun;47:95-100. doi: 10.1016/j.ijid.2016.06.003. Epub 2016 Jun 22. PMID: 27343987.
110. Chang J, Ye D, Lv B, Jiang M, Zhu S, Yan K, Tian Y, Fang Y. Sale of antibiotics without a prescription at community pharmacies in urban China: a multicentre cross-sectional survey. *J Antimicrob Chemother*. 2017 Apr 1;72(4):1235-1242. doi: 10.1093/jac/dkw519. PMID: 28062684.
111. Broom A, Broom J, Kirby E, Plage S, Adams J. What role do pharmacists play in mediating antibiotic use in hospitals? A qualitative study. *BMJ Open*. 2015 Nov 3;5(11):e008326. doi: 10.1136/bmjopen-2015-008326. PMID: 26534731; PMCID: PMC4636622.
112. Auta A, Hadi MA, Oga E, Adewuyi EO, Abdu-Aguye SN, Adeloye D, Strickland-Hodge B, Morgan DJ. Global access to antibiotics without prescription in community pharmacies: A systematic review and meta-analysis. *J Infect*. 2019 Jan;78(1):8-18. doi: 10.1016/j.jinf.2018.07.001. Epub 2018 Jul 5. PMID: 29981773.
113. Sakeena MHF, Bennett AA, McLachlan AJ. Non-prescription sales of antimicrobial agents at community pharmacies in developing countries: a systematic review. *Int J Antimicrob Agents*. 2018 Dec;52(6):771-782. doi: 10.1016/j.ijantimicag.2018.09.022. Epub 2018 Oct 9. PMID: 30312654.
114. Chang J, Xu S, Zhu S, Li Z, Yu J, Zhang Y, Zu J, Fang Y, Ross-Degnan D. Assessment of non-prescription antibiotic dispensing at community pharmacies in China with simulated clients: a mixed cross-sectional and longitudinal study. *Lancet Infect Dis*. 2019 Dec;19(12):1345-1354. doi: 10.1016/S1473-3099(19)30324-X. Epub 2019 Oct 3. Erratum in: *Lancet Infect Dis*. 2019 Oct 15; PMID: 31588042.
115. Kalungia AC, Burger J, Godman B, Costa JO, Simuwelu C. Non-prescription sale and dispensing of antibiotics in community pharmacies in Zambia. *Expert Rev Anti Infect Ther*. 2016 Dec;14(12):1215-1223. doi: 10.1080/14787210.2016.1227702. Epub 2016 Sep 9. PMID: 27548801.
116. Kotwani A, Wattal C, Joshi PC, Holloway K. Irrational use of antibiotics and role of the pharmacist: an insight from a qualitative study in New Delhi, India. *J Clin Pharm Ther*. 2012 Jun;37(3):308-12. doi: 10.1111/j.1365-2710.2011.01293.x. Epub 2011 Aug 23. PMID: 21883328.
117. Roque F, Herdeiro MT, Soares S, Teixeira Rodrigues A, Breitenfeld L, Figueiras A. Educational interventions to improve prescription and dispensing of antibiotics: a systematic review. *BMC Public Health*. 2014 Dec 15;14:1276. doi: 10.1186/1471-2458-14-1276. PMID: 25511932; PMCID: PMC4302109.
118. Kalonga J, Hangoma J, Banda M, Munkombwe D, Mudenda S. Antibiotic Prescribing Patterns in Paediatric Patients at Levy Mwanawasa University Teaching Hospital in Lusaka, Zambia. *Int J Pharm Pharmacol*. 2020;4(1):138. <https://bit.ly/3EuJzUe>
119. Zulu A, Matafwali SK, Banda M, Mudenda S. Assessment of knowledge, attitude, and practices on antibiotic resistance among undergraduate medical students in the school of medicine at the University of Zambia. *Int J Basic Clin Pharmacol*. 2020;9:263-270. doi: 10.18203/2319-2003.ijbcp20200174
120. Ministry of Health. Multisectoral National Action Plan on Antimicrobial Resistance, Zambia. 2017-2027. <https://bit.ly/31ebLw7>
121. Firouzabadi D, Mahmoudi L. Knowledge, attitude, and practice of health care workers towards antibiotic resistance and antimicrobial stewardship programmes: A cross-sectional study. *J Eval Clin Pract*. 2020 Feb;26(1):190-196. doi: 10.1111/jep.13177. Epub 2019 May 21. PMID: 31115129.
122. Kalungia AC, Mwambula H, Munkombwe D, Marshall S, Schellack N, May C, Jones ASC, Godman B. Antimicrobial stewardship knowledge and perception among physicians and pharmacists at leading tertiary teaching hospitals in Zambia: implications for future policy and practice. *J Chemother*. 2019 Nov-Dec;31(7-8):378-387. doi: 10.1080/1120009X.2019.1622293. Epub 2019 May 30. PMID: 31145043.

How to cite this article: Mudenda S, Hankombo M, Saleem Z, Sadiq MJ, Banda M, Munkombwe D, Mwila C, Kasanga M, Zulu AC, Hangoma JM, Mufwambi W, Muungo LT, Kampamba RM, Bambala AM, Abdulrahman NM, Akram M, Hikaambo CN, Muma JB. Knowledge, Attitude, and Practices of Community Pharmacists on Antibiotic Resistance and Antimicrobial Stewardship in Lusaka, Zambia. *J Biomed Res Environ Sci*. 2021 Oct 30; 2(10): 1005-1014. doi: 10.37871/jbres1343, Article ID: JBRES1343, Available at: <https://www.jelsciences.com/articles/jbres1343.pdf>