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Understanding Antimicrobial Resistance: Perspectives of Pharmacy Personnel and Nurses at a Tertiary Hospital, and Implications for Antimicrobial Stewardship Programs

Thuraya Taleb Albiji[1], Dalal Abdullah Alshammari[1], Mona Mohammad Alshammari[1], Tiflah Mohammad Alshammari[1], Munira Dughayyim Alshammari[1], Ola Tirki Alenazi[2]

1. **Staff Nurse, Directorate of Health Affairs, Hafar Al-Batin**
2. **Pharmacist, Directorate of Health Affairs, Hafar Al-Batin**

Abstract

Introduction: Antimicrobial resistance (AMR) is a pressing global health concern associated with heightened morbidity and mortality, particularly in low- and middle-income nations . This research assesses the understanding, attitudes, and behaviors concerning AMR among pharmacy staff and nurses

Methods: A descriptive cross-sectional study was undertaken, involving 263 participants who completed a structured questionnaire. Data analysis utilized IBM SPSS version 23.0, with statistical significance set at a 95% confidence level. Univariate analysis was employed to discern disparities in AMR knowledge, attitudes, and practices between pharmacy staff and nurses.

Results: Of the total participants, 225 (85.6%) were nurses, while 38 (14.4%) were pharmacy personnel. In comparison to nurses, pharmacy staff exhibited superior comprehension regarding the transmission of resistant bacteria (P = 0.001) and the role of antibiotic use in livestock in fostering AMR (P = 0.01). Additionally, pharmacy staff demonstrated more positive attitudes toward AMR as a public health concern (P = 0.001) and acknowledged the impact of antibiotic usage in livestock on resistant pathogen emergence (P = 0.001). Moreover, pharmacy personnel participated more actively in awareness campaigns (P = 0.029), pursued continued professional development (P = 0.001), and engaged in courses related to antibiotic use and AMR (P = 0.028).

Conclusions: The findings indicate that the majority of participants possessed satisfactory knowledge, positive attitudes, and commendable practices concerning AMR. Nonetheless, significant variations in AMR knowledge, attitudes, and practices were noted between pharmacy personnel and nurses, underscoring the necessity for enhanced educational initiatives tailored to these healthcare professionals.

Introduction

The escalating prevalence of antimicrobial resistance (AMR) poses a grave public health challenge and jeopardizes the considerable advancements achieved in combating infectious diseases. In 2019 alone, an estimated 4.95 million deaths were attributed to AMR, with over a million fatalities

directly linked to antibiotic resistance. Each year, drug-resistant infections, such as MRSA and MDR-TB, contribute to thousands of deaths, and projections suggest that by 2050, unchecked AMR could claim the lives of 10 million individuals. Concerns also abound that the COVID-19 pandemic may exacerbate the AMR threat due to the direct or indirect consequences of pandemic responses. While AMR presents a global challenge, its impact is disproportionately severe in low- and middle-income countries (LMICs) compared to high-income nations, largely due to the high incidence of infectious diseases in these regions. (Murray et al., 2021)

Several factors drive AMR, including the misuse and overuse of antimicrobials, inadequate access to clean water and hygiene for both humans and animals, and ineffective prevention and control of infections and diseases in healthcare facilities and agricultural settings. Additionally, antimicrobial misuse in animal husbandry has contributed significantly to AMR development. The lack of access to quality-assured medicines exacerbates AMR as patients are exposed to ineffective, substandard, or counterfeit drugs. Other drivers include insufficient awareness and knowledge regarding AMR and inadequate enforcement of legislation. Zambia, akin to other LMICs, reports high levels of irrational antimicrobial prescribing and dispensing, alongside prevalent self-medication, over-the-counter antibiotic purchases, and non-compliance, all of which fuel AMR. (Bumbangi et al., 2022)

Understanding antimicrobial activity and its correlation with resistance is crucial for establishing effective antibiotic use programs. One such initiative is the implementation of antimicrobial stewardship (AMS) programs in healthcare facilities, which promote the rational use of antimicrobials and have demonstrated significant benefits. Healthcare workers (HCWs), including pharmacy personnel and nurses, play pivotal roles in combating AMR as they are responsible for dispensing medicines and providing crucial information on their usage. While pharmacists are not prescribers, they play essential roles in consumer education and ensuring rational antibiotic use in hospitals, critical components in AMR mitigation. It's estimated that over 50% of antimicrobial use (AMU) in hospital settings is inappropriate, leading to adverse patient outcomes and AMR development. Nurses, with their consistent presence in in-patient care settings, are ideally positioned to ensure the correct administration of antimicrobial agents. (Hedman et al., 2020)

The success of AMS programs hinges on various factors, including a multidisciplinary approach, HCW knowledge, attitudes, and practices, healthcare infrastructure challenges, policy implementation gaps, and inadequate surveillance systems and governance. To effectively address the AMR threat and implement successful AMS programs, HCWs must be equipped with accurate information. Despite efforts to establish AMS programs, there remains scant data on HCWs' knowledge, attitudes, and practices regarding AMR at Ndola Teaching Hospital (NTH), Zambia's second-largest hospital. Therefore, this study aims to evaluate the knowledge, attitudes, and practices of pharmacy personnel and nurses at NTH in Ndola, Zambia, regarding AMR. (Mudenda et al., 2022)

Methods

Study Design, Site, and Population:

This cross-sectional study was conducted on assessing knowledge, attitudes, and practices regarding antibiotic resistance among pharmacy personnel and nurses. . The study targeted pharmacy personnel and nurses engaged in the dispensing, administration, and counseling of patients on antibiotic usage. Eligible participants were employees of NTH who provided consent

to participate in the study. Those on leave during the data collection period were excluded. Enrolled and registered nurses representing various hospital wards, including inpatient, outpatient, adult, medical, and surgical, were included, while pharmacy and nursing students were excluded.

Sample Size Estimation and Sampling Technique:

The sample sizes of pharmacy personnel and nurses were determined independently using Yamane's formula: n = N / (1 + N(e)^2). The study site comprised 513 nurses and 42 pharmacy personnel. With a confidence level of 95% and a margin of error of 5%, a minimum of 253 participants was required, accounting for a 10% incomplete response or loss to follow-up. Convenience sampling was employed due to the shift work schedules. Data collection was conducted during morning, afternoon, evening, and night shifts to enhance the likelihood of sampling all potential participants. A total of 265 questionnaires were distributed to 230 nurses and 35 pharmacy personnel.

Data Collection Tool:

Questionnaires were administered to willing pharmacy personnel and nurses meeting the inclusion criteria. The questionnaire comprised sections on knowledge about AMR and its causes, attitudes toward AMR, practices for AMR control, and socio-demographic characteristics of participants. Correct responses were scored as 1, while incorrect responses received a score of 0, with a maximum score of 6 for knowledge, attitudes, and practices. Based on previous research, scores ≥80% were classified as good, scores between 60% and 79% as moderate, and scores less than 60% as poor. The questionnaire was adapted from similar studies and underwent pilot testing for consistency, length, and relevance. Data were collected by trained data collectors , and questionnaire completion took between 15 and 30 minutes.

Data Analysis:

Collected data were entered into Microsoft Excel and analyzed using IBM SPSS version 23.0. Descriptive statistics were used to present the analyzed data in tables. Statistical tests were conducted at a 95% confidence level. Univariate analysis was employed to determine differences in knowledge, attitudes, and practices regarding AMR between pharmacy personnel and nurses.

Ethics Approval:

Ethical clearance for the study was obtained from the Tropical Diseases Research Centre (TDRC) and the National Health Research Authority (NHRA). Institutional clearance was also obtained from the NTH administration. Informed consent was obtained from all participants, ensuring privacy and confidentiality regarding the collected information.

Results

Sociodemographic Characteristics of Participants:

Table 1 presents data on 263 health workers participating in the study. The majority were female (82.1%) and over 30 years of age (56.7%). Nurses constituted the predominant group (85.6%). A significant proportion held Bachelor's degrees (61.2%), and a majority reported work experience ranging from 1 to 5 years (45.2%).

Table 1: Sociodemographic Characteristics of Participants (n = 263)

Variable	Category	Frequency (n, %) for Nurses	Frequency (n, %) for Pharmacists	P value
Gender	Female	195 (90.3)	21 (9.7)	0.001
	Male	30 (63.8)	17 (36.2)	
Age (years)	≥30	143 (96.0)	6 (4.0)	0.001
	<30	82 (71.9)	32 (28.1)	
Qualification	Certificate	12 (100)	0 (0.0)	0.001
	Diploma	157 (97.5)	4 (2.5)	
	Bachelors' degree	56 (62.9)	33 (37.1)	
	Master's degree	0 (0.0)	1 (100)	
Work experience	<1	0 (0.0)	5 (100)	0.001
(years)	1–5	96 (80.7)	23 (19.3)	
	6–10	34 (85.0)	6 (15.0)	
	>10	95 (96.0)	4 (4.0)	

P values were calculated using chi-square tests.

Knowledge, Attitudes, and Practices of Participants on AMR:

Table 2 highlights that a vast majority of participants recognized the incorrectness of using antibiotics leftover by others (97%) and acknowledged the challenge of treating infections caused by resistant bacteria (85.9%). However, only about half (54.4%) perceived AMR as a significant public health issue. Notably, a majority (60.1%) of participants had never engaged in campaigns promoting optimal antibiotic use. Pharmacy personnel exhibited more favorable attitudes toward AMR as a global concern and recognized livestock as a potential source of new resistant pathogens. They also demonstrated better engagement in campaigns, continuous professional development (CPD), and participation in AMR-related courses.

Table 2: Knowledge, Attitudes, and Practices of Participants on AMR

Variable	Questions	Professional Category	Yes, n	No, n	P value
Knowledge questions	1. It is okay for someone to use antibiotics that were administered to a friend or family member, as long as they were used to treat the same illness (correct answer = 'No')	Pharmacy personnel	2	36	0.325
	Nurse		6	219	
	2. Many infections are increasingly resistant to antibiotic treatment (correct answer = 'Yes')	Pharmacy personnel	28	10	0.273
	Nurse		151	74	
	3. Infections caused by antibiotic-resistant bacteria are difficult or impossible to treat (correct answer = 'Yes')	Pharmacy personnel	33	5	0.548
	Nurse		193	32	
	4. Antibiotic resistance is an issue in other countries but not in ours (correct answer = 'No')	Pharmacy personnel	3	35	0.130
	Nurse		37	188	
	5. Bacteria that are resistant to antibiotics can be spread from person to person (correct answer = 'Yes')	Pharmacy personnel	33	5	0.001
	Nurse		105	120	
	6. The risk of antimicrobial resistance increases in individuals that consume livestock that is treated with	Pharmacy personnel	18	20	0.010

	antimicrobials (correct answer = 'Yes')				
	Nurse		60	165	
Attitude questions	1. Antibiotic resistance is a major public health problem in our country (correct answer = 'Yes')	Pharmacy personnel	34	4	0.001
	Nurse		109	116	
	2. The fact that one is taking an antibiotic increases the chances of developing resistance (correct answer = 'Yes')	Pharmacy personnel	15	23	0.330
	Nurse		101	124	
	3. New antibiotic development can solve antibiotic resistance problems (correct answer = 'Yes')	Pharmacy personnel	20	18	0.435
	Nurse		125	100	
	4. The use of antibiotics in livestock animals is an important cause of the appearance of new resistance to pathogenic agents in humans (correct answer = 'Yes')	Pharmacy personnel	26	12	0.001
	Nurse		56	169	
	5. In all cases where antibiotics are dispensed, it is important that patients are advised about complying with the treatment (correct answer = 'Yes')	Pharmacy personnel	37	1	0.094
	Nurse		201	24	
	6. There is need to establish a course on the 'rational use of antibiotics' (correct answer = 'Yes')	Pharmacy personnel	36	2	0.076
	Nurse		191	34	
Practice questions	1. I educate people on the use of antibiotics and resistance related issues whenever I can (correct answer = 'Yes')	Pharmacy personnel	35	3	0.372

	Nurse		213	12	
	2. I participate in antibiotic awareness campaigns to promote the optimal use of antibiotics (correct answer = 'Yes')	Pharmacy personnel	21	17	0.029
	Nurse		84	141	
	3. I have attended Continuing Professional Development (CPD) education on antibiotic use and resistance topics (correct answer = 'Yes')	Pharmacy personnel	22	16	0.001
	Nurse		54	171	
	4. I have taken courses to improve my knowledge of antimicrobial resistance and antibiotic use (correct answer = 'Yes')	Pharmacy personnel	17	21	0.028
	Nurse		62	163	
	5. I follow the standard treatment guidelines when dealing with infectious diseases (correct answer = 'Yes')	Pharmacy personnel	37	1	0.094
	Nurse		201	24	
	6. I adhere to infection control guidelines established at our facility (correct answer = 'Yes')	Pharmacy personnel	36	2	0.539
	Nurse		215	10	

P values were calculated using chi-square tests.

Differences in Knowledge, Attitudes, and Practices Regarding AMU and AMR Among Nurses (n = 225):

Table 3 reveals that most diploma and degree-holding nurses were unaware of the heightened risk of AMR development among individuals consuming livestock treated with antibiotics. Additionally, a significant proportion of diploma holders had not participated in AMR campaigns, CPD activities, or taken courses to enhance their knowledge and practices regarding AMR (P = 0.001).

Table 3: Difference in Knowledge, Attitudes, and Practices Regarding AMU and AMR Among Nurses (n = 225)

Questions	Qualifications	Yes	No	P value

Bacteria that are resistant to antibiotics can be spread from person to person	Certificate	6	6	0.176
	Diploma	67	90	
	Degree	32	24	
The risk of antimicrobial resistance increases in individuals that consume livestock that is treated with antimicrobials	Certificate	6	6	0.013
	Diploma	46	111	
	Degree	8	48	
Antibiotic resistance is a major public health problem in our country	Certificate	6	6	0.294
	Diploma	71	86	
	Degree	32	24	
The use of antibiotics in livestock animals is an important cause of the appearance of new resistance to pathogenic agents in humans	Certificate	6	6	0.073
	Diploma	34	123	
	Degree	16	40	
I participate in antibiotic awareness campaigns to promote the optimal use of antibiotics	Certificate	12	0	0.001
	Diploma	44	113	
	Degree	28	28	
I have attended Continuing Professional Development (CPD) education on antibiotic use and resistance topics	Certificate	6	6	0.001
	Diploma	26	131	
	Degree	22	34	
I have taken courses to improve my knowledge of antimicrobial resistance and antibiotic use	Certificate	0	12	0.001
	Diploma	28	129	
	Degree	34	22	

Overall, Knowledge, Attitudes, and Practices Regarding AMR Among Study Participants:
Overall, participants scored 70%, 60%, and 64% on knowledge, attitudes, and practices related to AMR, respectively, indicating a moderate level of understanding, attitudes, and practices concerning AMR (Table 4).

Table 4: Overall Knowledge, Attitudes, and Practices Regarding AMR Among Participants

Variable	Scores (%)
Knowledge	70
Attitudes	60
Practices	64

Discussion

The study aimed to assess the knowledge, attitudes, and practices (KAP) regarding antimicrobial resistance (AMR) among pharmacy and nursing personnel. The findings revealed moderate scores in knowledge, attitudes, and practices related to AMR among the participants. (Shafiq et al., 2021)
The study identified several key points. Firstly, most participants recognized the importance of not sharing antibiotics with friends or family members, which is crucial in curbing self-medication practices that contribute to AMR. However, there were gaps in understanding among diploma-holder nurses regarding the spread of antibiotic-resistant bacteria from person to person, highlighting the need for targeted education initiatives. (Cuevas et al., 2021)
Interestingly, pharmacists showed better awareness of AMR as a public health problem compared to nurses. This could be attributed to their higher participation in campaigns and continuous professional development activities related to antibiotic use and resistance. Targeted educational interventions tailored to the specific needs of nurses may help bridge this gap. (Kalonga et al., 2020)
Furthermore, a significant proportion of participants, particularly diploma and degree-holder nurses, lacked awareness of the link between antibiotic use in livestock and the development of antibiotic-resistant pathogens in humans. This underscores the importance of disseminating this information among healthcare workers to address this misconception. (Zulu et al., 2020)
Overall, the study underscores the importance of enhancing education and training initiatives on AMR among healthcare personnel. Strengthening antimicrobial stewardship programs and implementing educational interventions tailored to the needs of different healthcare professionals can help improve knowledge, attitudes, and practices related to antibiotic use and resistance. (Banda et al., 2021)
Despite these insights, the study has some limitations. The cross-sectional design limits the ability to establish causality, and the findings may not be generalizable beyond the study population at Ndola Teaching Hospital. Additionally, self-reporting bias and social desirability bias may have influenced participants' responses. Further research incorporating longitudinal designs and broader participant samples could provide more comprehensive insights into KAP regarding AMR among healthcare personnel in Zambia. (Kirby et al., 2020)
Firstly, the study's revelation of moderate scores in KAP regarding AMR among participants underscores the urgent need for targeted interventions to enhance awareness and understanding of AMR within healthcare settings. Given the critical role that healthcare workers play in prescribing, dispensing, and administering antibiotics, ensuring they possess accurate and comprehensive knowledge about AMR is paramount. (D'Arcy et al., 2021)
One key takeaway is the disparity in awareness between pharmacists and nurses, with pharmacists demonstrating better understanding of AMR as a public health issue. This suggests the effectiveness of current educational initiatives, such as campaigns and continuous professional development activities, in reaching pharmacists. Extending similar educational opportunities to nurses, tailored to their specific needs and preferences, could help bridge this gap and ensure a more unified approach to combating AMR across healthcare professions. (Rolfe et al., 2021)
Moreover, addressing misconceptions and gaps in knowledge, particularly regarding the spread of antibiotic-resistant bacteria from person to person and the link between antibiotic use in livestock and the development of resistance, requires targeted educational interventions. These initiatives should emphasize evidence-based information and practical strategies for promoting judicious antibiotic use in both clinical and community settings. (Cheoun et al., 2021)

Additionally, the study highlights the importance of strengthening antimicrobial stewardship programs (AMS) within healthcare facilities. These programs play a crucial role in promoting appropriate antibiotic prescribing practices, optimizing patient outcomes, and minimizing the emergence of AMR. By integrating comprehensive AMS initiatives into clinical practice, healthcare facilities can empower staff to make informed decisions regarding antibiotic use and resistance. (Lim et al., 2021)

Lastly, while the study provides valuable insights into KAP regarding AMR among healthcare personnel at Ndola Teaching Hospital, further research is needed to validate these findings across diverse healthcare settings in Zambia. Longitudinal studies tracking changes in KAP over time and qualitative research exploring the underlying factors influencing healthcare workers' attitudes and behaviors towards AMR could provide deeper insights into this complex issue. (Özcebe et al., 2022)

In conclusion, addressing the identified gaps in KAP regarding AMR among healthcare personnel requires a multifaceted approach encompassing targeted education, strengthening of AMS programs, and ongoing research to inform evidence-based interventions. By empowering healthcare workers with the knowledge and resources needed to combat AMR effectively, we can work towards preserving the efficacy of antibiotics and safeguarding public health for future generations. (Ashiru-Oredope et al., 2021)

Conclusion:

In conclusion, while this study reveals moderate levels of knowledge, positive attitudes, and acceptable practices regarding AMR among nurses and pharmacists, it underscores the need for ongoing education and awareness campaigns across the healthcare workforce. Despite limitations in scope, the study provides valuable insights into the current landscape of AMR awareness and practices among key healthcare professionals. Addressing identified knowledge gaps and promoting responsible antimicrobial use through targeted interventions are critical steps in combating the escalating threat of AMR and safeguarding public health .

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