TANZANIA MEDICAL JOURNAL
Ntissi et al. TMJ V 36 No. 4. December 2025

Original Research Open Access

Factors Influencing Antibiotic Prescribing Decisions among Healthcare Providers in Tanzania: Implications for Antimicrobial Stewardship

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Abstract

Introduction: Understanding the factors that influence antimicrobial prescription decisions among healthcare providers is essential for designing more effective antimicrobial stewardship programs to combat antimicrobial resistance (AMR).
Methodology: We conducted a cross-sectional study utilising a questionnaire among healthcare providers (doctors, pharmacists, nurses, and laboratory personnel) in Tanzania to explore their knowledge and attitudes towards AMR and antimicrobial use (AMU), as well as the factors influencing their prescribing and dispensing practices. The survey collected information on their educational and professional backgrounds, fields of clinical practice, sources of information on AMR and AMU, and factors influencing their decision-making. Descriptive statistics were used to report healthcare practitioners' levels of practice, knowledge, and attitudes toward AMR and AMU. Binary logistic regression was used to associate sociodemographic attributes with AMR and AMU knowledge.
Results: Among 138 participants, 37.7% (n=52) were female, with a mean age of 37 ± 10.5 years. AMR/AMU training in the past year was reported by 45.7% (n=63). The main sources of information were the World Health Organization (WHO) guidelines 21.4% (n=71) and national guidelines 20.2% (n=67). Key factors influencing antimicrobial prescriptions were the ready availability at the local level 68.8% (n=95), the potential rise of resistant bacteria 57.2% (n=79), and the economic status of the client 55.1% (n=76). Respondents reported high levels of knowledge in selecting routes of administration 63.8% (n=88) and interpreting microbiological results 63.0% (n=87). In contrast, lower awareness was reported for the National Action Plan for AMR 29.3% (n=40) and the reserve category of antimicrobials 37.7% (n=52). The knowledge scale demonstrated high reliability (Cronbach's alpha = 0.92). Binary logistic regression analysis showed that being a nurse (AOR = 0.10, p = 0.043) and being a laboratory scientist (AOR = 0.27, p = 0.026) were significantly associated with lower knowledge of AMR/AMU.
Conclusion: This study reveals gaps in knowledge and awareness of AMR and AMU among healthcare providers in Tanzania, particularly regarding the National Action Plan and the WHO reserve group of antimicrobials. These findings underscore the need for targeted education and professional development, especially for nurses and laboratory scientists, to strengthen antimicrobial stewardship and reduce AMR risk.

Keywords: *Antibiotic, Antimicrobial stewardship, Prescription decision-making, Healthcare provider, Tanzania.*

Introduction

Antimicrobial resistance (AMR) is a growing global challenge to public health and economic development (1). Globally, without appropriate multisectoral interventions, the percentage of infections caused by AMR pathogens is expected to increase from 20.3% in 2010 to 22.5% in 2020 and 23.9% in 2030 (1). According to projections, the annual number of deaths directly attributed to AMR has increased from 700,000 in 2021 to 10 million, and the economic cost is expected to increase from 3 trillion USD in 2021 to 100 trillion USD in 2050 (1–3). Based on predictive statistical models, there were an estimated 4.95 million (3·62–6·57) deaths associated with bacterial AMR in 2019, including 1·27 million (95% UI 0·911–1·71) deaths attributable to bacterial AMR (1). These deaths were higher than those due to HIV/AIDS and malaria combined, which in 2019 were estimated to have caused 860,000 and 640,000 deaths, respectively (1).

Although AMR is a global issue, it is of a greater concern in low- and middle-income countries (LMICs), with Asia and Africa accounting for 8,880,000 of the expected 10 million deaths by 2050 (4). Africa alone is expected to contribute to 4,150,000 deaths, which could be considered the hardest hit region compared to its population (1).

In the African region, the all-age death rate attributable to AMR is the highest (27·3 deaths per 100 000) in western sub-Saharan Africa, followed by the Eastern Africa region at 21.4 deaths per 100 000 (5). Recent reviews have indicated high levels of multidrug-resistant (MDR) pathogens in humans, animals, and the environment, ranging from 20% to 70% of all bacterial isolates, occasionally due to high antimicrobial usage (6,7).

Recent studies conducted in health facilities in Tanzania have shown that the proportion of MDR bacteria in clinical isolates ranges from 30 to 70%, with some strains showing resistance to more than six different classes of antibiotics (8–11). Although this situation has been associated with several factors, the common denominator is the overuse and abuse of antibiotics (12,13). One area of particular concern is the misuse of antibiotics in health facilities, where there is i) a lack of regularly updated standard treatment guidelines (14), ii) inadequate access to appropriate antimicrobial therapy, and (iii) a weak regulatory framework for the use of antibiotics (6,15). In addition, health practitioners across the spectrum face serious challenges, such as a lack of continuing medical education on AMU, which is often associated with failure to observe the recommended therapeutic doses (16), poor quality of medicines (17,18), use of incorrect routes of administration, and prescription of arbitrary drug combinations (19,20).

Promoting the rational use of antimicrobials among healthcare providers is essential to prevent health facilities from becoming drivers of AMR (21). However, this requires the appropriate knowledge, attitudes, and practices (KAP) of healthcare workers regarding AMU and AMR.

This study aimed to investigate the impact of KAP on antimicrobial prescription practices among healthcare providers in Tanzania. The participants were from different disciplines, including doctors, pharmacists, nurses, and laboratory staff. Our working hypothesis is that healthcare providers' appropriate KAP regarding AMU are crucial in keeping them effective in de-escalating the emergence and spread of AMR bacteria and genes within hospital settings and the surrounding environment, as shown in a recent study (22). We expect that the results of this survey will provide valuable insights that can be used to improve antimicrobial prescription practices, reduce the AMR burden in Tanzania, and contribute to global efforts to combat this challenge.

Material and methods

Study location

The study targeted members attending the AMR workshop and the 11th Muhimbili University of Health and Allied Sciences (MUHAS) Scientific Conference in 2023. These attendees came from various regions across Tanzania and represented diverse groups of healthcare providers. Approximately 400 participants attended the conference and workshop and were invited to complete the survey during the events. In addition, the survey link was distributed through professional networks and mailing lists, reaching an estimated 200 more healthcare providers across Tanzania.

Study Design

This study adopted a questionnaire-based cross-sectional design. This design enabled researchers to collect data from 16th May 2023 to 4th July 2023, capturing the KAP of healthcare providers in Tanzania regarding AMR and AMU.

Participants

This study targeted healthcare providers in Tanzania who prescribe, dispense, or conduct laboratory tests for antimicrobial agents in their practices. A convenience sampling approach was employed, focusing on healthcare providers who attended AMR and AMU workshops and symposia in various regions of Tanzania. Written informed consent was obtained after participants were fully informed about the study objectives, and those who declined participation were excluded without any consequences.

Data Collection

Data were collected using a self-administered questionnaire. Before completing the questionnaire, the participants were asked to read the instructions and provide their consent to proceed with the study. The survey was automatically stopped if the participant refused consent and no more information was collected. The questionnaire was divided into five sections, soliciting personal information, sources of knowledge about AMR and AMU, and the influence of practice factors, knowledge factors, and attitude factors regarding antimicrobial prescriptions. The first section involved collecting information on participants' personal characteristics, including age, gender, level of education, years of experience in practice, profession, and whether they had attended any training on AMR and AMU in the last year. The second section investigated the sources of knowledge that healthcare providers rely on for AMR and AMU. Participants were asked to select their sources from a list of options, including microbiologists, pharmaceutical companies, WHO guidelines, national guidelines or protocols, Internet sources, experience in managing similar problems, senior colleagues, and previous knowledge or training. The third section explored the influence of practice factors on antimicrobial prescriptions. Participants were asked to rate on a four-point Likert scale (no influence, minimal influence, moderate influence, and high influence) their perceptions of different factors, such as i) the route of administration, ii) the potential rise of resistant bacteria in patients, iii) potential adverse or side effects of taking antibiotics or patient safety, iv) readily available at the local level, v) economic status of the client, vi) guideline recommendations/drug instruction, vii) culture and susceptibility test results, viii) patients' previous AMU history, and ix) clinical signs and organism/disease type. The fourth section assessed the participants' knowledge of different aspects of AMR and AMU using a four-point Likert scale (not at all, poor, medium, and good). These questions explored knowledge: i) classes and generations of antibiotics, ii) interpreting microbiological/laboratory results, iii) choosing the correct antimicrobial, iv) choosing the correct dose/dosage of antimicrobials, v) choosing routes of antimicrobial administration (oral vs. intravenous vs. topical), vi) using a combination of antimicrobials, if appropriate, vii) planning the duration of the specific antimicrobial treatment, viii) modifying/stopping antimicrobial treatments if required, ix) knowledge of the reserve group of antimicrobials, x) knowledge of the critically important list of antimicrobials specified by the WHO, xi) knowledge of the NAP on AMR, and xii) knowledge of the mechanisms and causes of AMR.

The fifth section assessed participants' attitudes towards antimicrobial resistance using a four-point Likert scale (strongly agree, agree, disagree, and strongly disagree). The questions explored attitudes towards i) the threat of AMR, ii) the impact of a single course of antibiotics on AMR, iii) the role of inappropriate antibiotic use in animals in antibiotic resistance in humans, and the natural and anthropogenic causes of AMR, iv) the future of AMR, v) the potential for new antibiotic development in solving antibiotic resistance problems, vi) the difficulty in selecting the correct antimicrobials, vii) the availability of sufficient sources of information on antimicrobials and their usage, viii) agreement with restricting priority antibiotics for human use only, and ix) restriction of antibiotic usage.

Sample size calculations

The sample size (n) was calculated using the formula $n = Z^2P(1 - P)/d^2$ (23), where, n = sample size, Z = Z statistic corresponding to a chosen confidence level, P = expected prevalence, d = precision. At a 95% confidence interval, the Z statistic was 1.96 and P was 44.7% from a previous public survey of AMR and AMU in the Western Region of Saudi Arabia (24). The degree of precision (d) was set to 5% non-response. This calculation resulted in a sample size of 380 participants for inclusion in the study.

Scoring of the knowledge of participants

Knowledge scoring in this study was based on two sets of questions. In the first set, respondents were asked to rate their knowledge of each of the 12 factors provided in Section 4. They were required to select one choice from Not at all, Poor, Medium, and Good for each question, with scores assigned as follows: not at all = 1, poor = 2, medium = 3, and good = 4. The maximum possible score in this section was 48, calculated by multiplying the number of questions (12) by the highest score (4) attainable for each question.

In the second set of questions, Section 5 asked respondents to rate their responses on a four-point Likert scale: strongly agree, agree, disagree, and strongly disagree. The scores were assigned as follows: strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1. Some questions in this section were reverse-coded, meaning that the correct answer was assigned a score of 4; however, when the correct response was 1, it was coded as 4 to account for reverse scoring. The maximum possible score in this section was 40 (10 questions × 4 points).

For the analysis, knowledge scores were treated as both continuous and categorical variables. A cut-off score of 36 was applied: respondents scoring ≤35 were classified as having poor knowledge, and those scoring ≥36 were classified as having good knowledge. This threshold was determined from the distribution of scores and approaches used in related KAP studies.

Data analysis

Data analyses were performed using SPSS version 27.0. Descriptive statistics (means, standard deviations, and frequencies) were used to summarise the data. The internal consistency of the 12 knowledge items was assessed using Cronbach's alpha; a coefficient ≥0.70 was considered acceptable, and the scale achieved an alpha of 0.92, indicating excellent reliability. Pearson's correlation coefficients were used to assess linear relationships among knowledge, practice, and attitude scores. Chi-square tests and binary logistic regression were applied to examine the associations between participant characteristics and knowledge, with statistical significance set at $p < 0.05$.

Ethical considerations

Participation in the study was voluntary. The study was granted ethical approval from the Directorate of Research, Publications and Innovations of the MUHAS with approval number MUHAS-REC-12-2023-1991. Written informed consent was obtained after the participants were informed of the study objectives. Detailed information was provided to the participants to ensure that they understood the nature of the study and what they would be asked. Patients who refused to provide consent without adverse consequences were excluded. This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Results

A total of 163 individuals accessed the survey link. Of these, 3.1% (n=5) did not provide consent and were therefore excluded immediately, whereas 12.3% (n=20) were excluded because of incomplete records (n=16) or because they were not healthcare professionals (n=4). The remaining 84.7% (n=138) provided consent and complete, eligible data, and were included in the final analysis. Of the 138 participants, 62.3% (n=86) were male. The mean age was 37 years (SD = 10.5), and the mean duration of professional practice was 10.2 years (SD = 9.4). Most participants held a graduate degree (41.3%, n=57) or a postgraduate degree (39.1%, n=54). By profession, the largest groups were medical doctors, 39.9% (n=55) and pharmacists, 23.2% (n=32), followed by smaller proportions of laboratory scientists, microbiologists, nurses, and others (Table 1).

AMR/AMU training in the past year

When participants were asked whether they had received recent training on AMR and AMU, 54.3% (n=75) reported no training in the previous year (Table 1)

Sources of information

The 138 respondents provided a cumulative 332 responses when reporting multiple sources of information on AMR and AMU. The most commonly cited source was the WHO guidelines, which were reported by 21.4% (n=71) of the participants. National guidelines or protocols were also frequently mentioned, with 20.2% (n=67) relying on them. Other sources included the Internet, microbiology professionals, peer knowledge sharing, and pharmaceutical companies, the latter of which were identified by 3.0% (n=10) of the participants (Figure 1) (Participants selected more than one source).

Table 1: Participant characteristics (N =138)

Attribute		N	%	Mean	Std deviation
Gender	Male	86	62.3		
	Female	52	37.7		
Age				37	10.476
Years of experience in practice				10.22	9.396
Level of education	Graduate	57	41.3		
	Postgraduate	54	39.1		
	PhD	14	10.1		
	Diploma/Advanced Diploma	13	9.4		
Profession	Medical doctor	55	39.9		
	Pharmacist	32	23.2		
	Laboratory scientist	17	12.3		
	Microbiologist	13	9.4		
	Dentist	5	3.6		
	Nurse	5	3.6		
	Environmental officer	4	2.9		
	Veterinary doctor	3	2.2		
	Agricultural officer	1	0.7		
	Other*	3	2.2		
*Other Professions	Geneticist	1	0.7		
	Phytomedicine	1	0.7		
	Tropical disease control specialist	1	0.7		
Any training on AMR and AMU in the last year	No	75	54.3		
	Yes	63	45.7		

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Rating of factors influencing antimicrobial prescriptions

Of the factors rated (Figure 2), the highest influence was reported for "readily availability at the local level" 68.8% (n=95), followed by "potential rise of resistant bacteria in patients" 57.2% (n=79) and "economic status of the client" 55.1% (n=76). The influence rating decreased in the following order: route of administration, culture and susceptibility test results, organism/disease type, and patient AMU history. Lower levels of influence were reported for guideline recommendations/drug instructions 34.1% (n=47) and clinical signs 38.4% (n=53) (Figure 2).

Rating knowledge about AMR and AMU

A higher level of knowledge was reported for choosing routes of antimicrobial administration 63.8% (n=88) and interpreting microbiological/laboratory results 63.0% (n=87), with the majority of respondents rating their knowledge as good (Figure 2). Similarly, 59.4% (n=82) reported good knowledge of choosing the correct dosage of antimicrobials, and 58.0% (n=80) reported good knowledge of different classes and generations of antibiotics (Figure 3). In contrast, lower ratings were observed for knowledge of the National Action Plan for AMR (NAP on AMR) 29.2% (n=40) and for knowledge of the reserve group of antimicrobials 37.7% (n=52) (Figure 3

Reliability scale on knowledge score

The reliability analysis yielded a Cronbach's alpha of 0.92 for the 12 knowledge questions included in the study, indicating a high level of internal consistency.

KAP Scores

The participants' practice scores had a mean of 26.0 (SD± 2.3), while the knowledge displayed a mean of 38.9 (SD ± 6.6). In addition, participants' attitude scores, which gauged their attitudes toward AMR and related issues, had a mean of 18.1 (SD±5.1).

Associations between demographic factors, knowledge, attitudes, and practices

Using a knowledge score cut-off of 36, 32.8% (n = 45) of the 137 respondents who completed the knowledge questions were classified as having poor knowledge, while 67.2% (n = 92) were categorised as having good knowledge.

Pearson's correlation analysis (Table 2) revealed a statistically significant but weak negative association between practice and attitude scores ($r = -0.18$, $p = 0.045$), indicating that higher attitude scores were modestly linked to lower practice scores

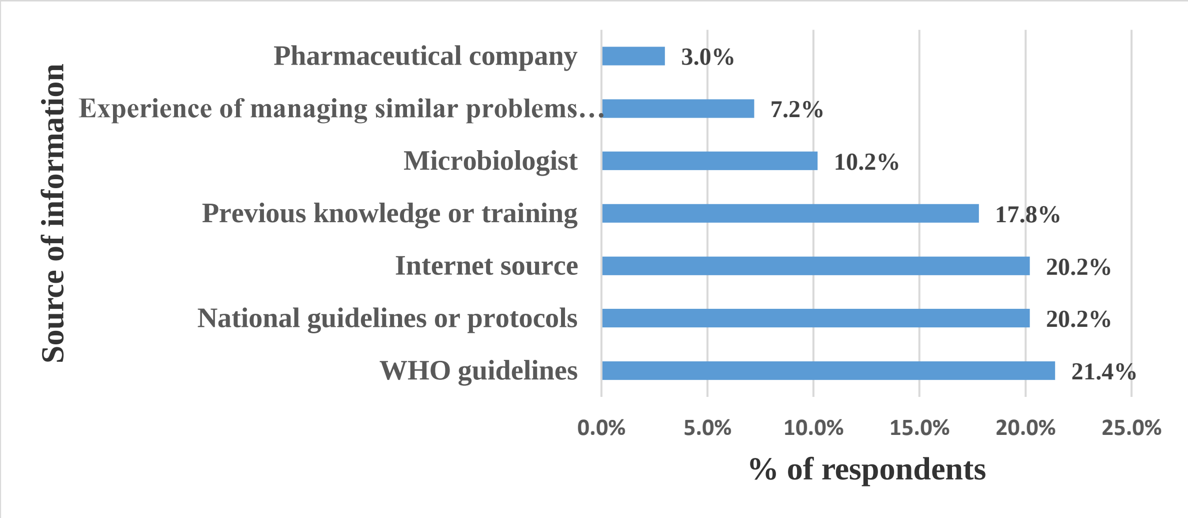

Figure 1. Participants' sources of information on AMR and AMU

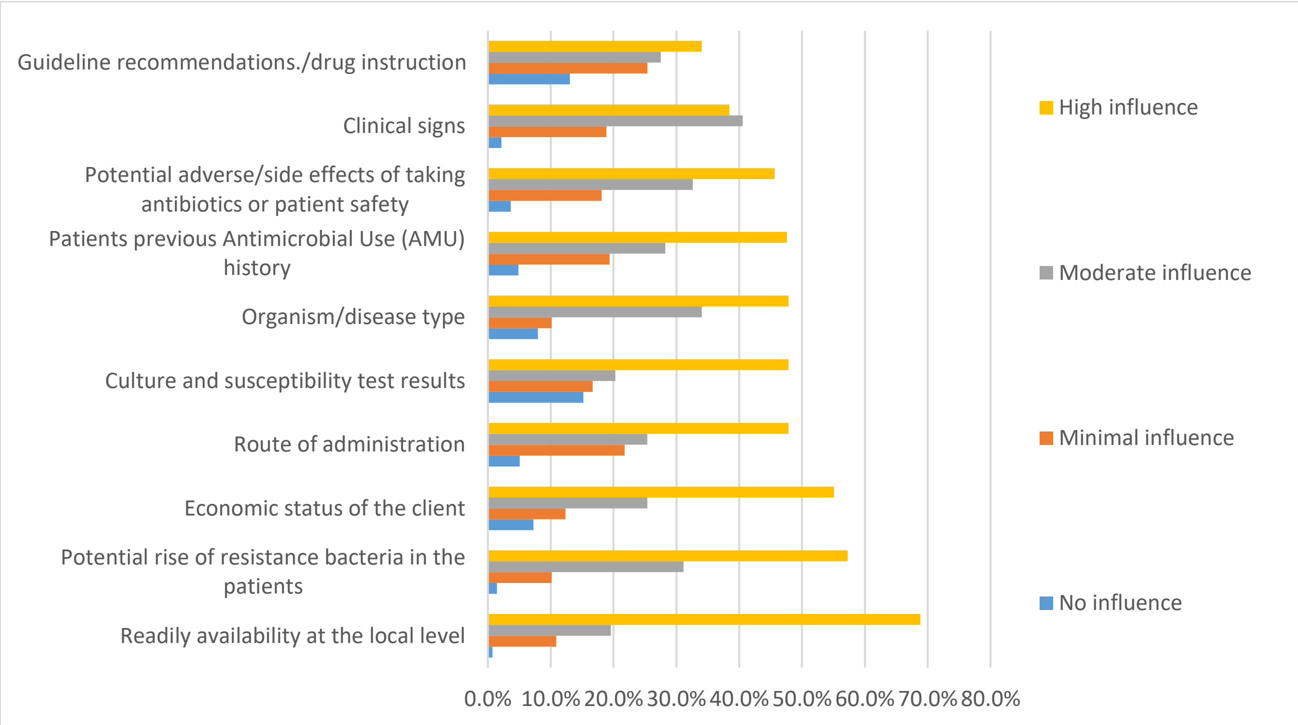

Figure 2. Respondents' ratings of how selected attributes influence their practices regarding antimicrobial prescription

Likert scale to rate the attitude of respondents

The factors that respondents strongly related to AMR in the future and the link between inappropriate antibiotic use in animals and resistance in humans are shown in (Figure 4). Additionally, a significant percentage of respondents supported imposing restrictions on antibiotic usage and prioritising antibiotics for human use.

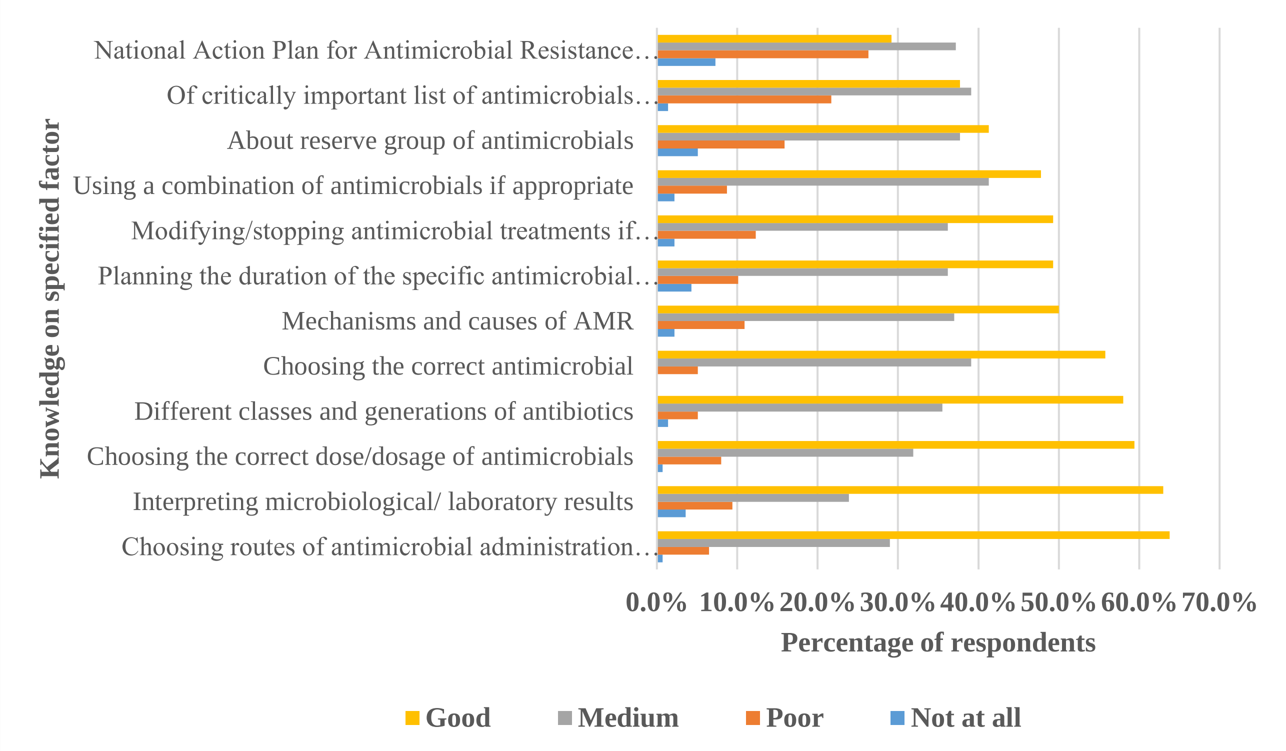

Figure 3. Rating respondents' knowledge of AMR and AMU

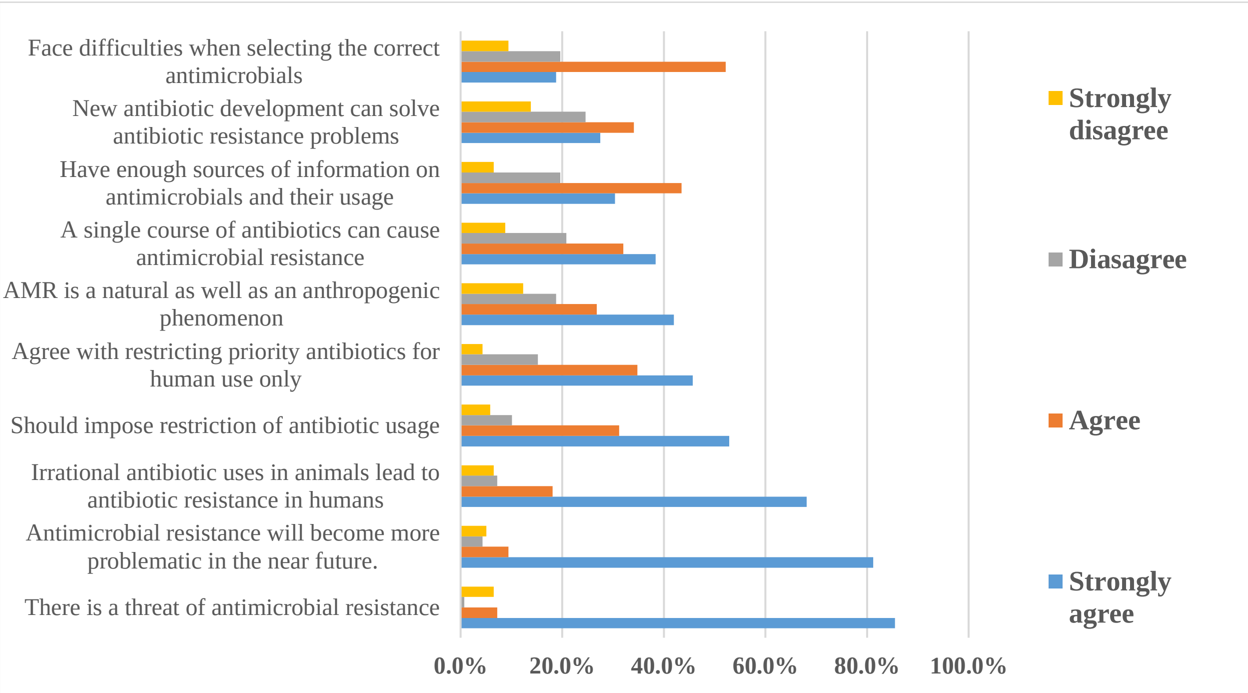

Figure 4. Likert scale to rate response in response to attitude scores

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Table 2: Pearson correlation coefficients between practice, knowledge and attitude scores among the participants

		Practice Score	Knowledge Score	Attitude Score
Practice Score	Pearson Correlation (r)	1	-0.07	-0.18
	P-value		0.460	0.045
	N	124	123	124
Knowledge Score	Pearson Correlation (r)	-0.07	1	-0.091
	P-value	0.460		0.313
	N	123	137	124
Attitude Score	Pearson Correlation (r)	-0.18	-0.09	1
	P-value	0.045	0.313	
	N	124	124	125

In the binary logistic regression analysis (Table 3), gender, age, and years of experience were not significantly associated with knowledge of AMR and AMU (p > 0.05). However, being a nurse was significantly associated with less knowledge (AOR = 0.10, p = 0.043). Similarly, being a laboratory scientist was negatively associated with knowledge, both in the crude model (COR = 0.27, 95% CI: 0.09–0.84, p = 0.023) and after adjustment for gender (AOR = 0.27, 95% CI: 0.09–0.86, p = 0.026).

Table 3: Binary and adjusted logistic regression analysis of the factors associated with respondents' knowledge of AMR and AMU

Attribute		COR (95% CI)	p-value	AOR (95% CI)	p-value
Gender	Male	1.00			
	Female	0.58 (0.28-1.20)	0.143	0.74 (0.33 - 1.63)	0.448
Age		1.01 (0.98-1.05)	0.519		
Years of experience in practice		1.02 (0.98-1.06)	0.320		
Level of education	Diploma/Advanced Diploma	1.00			
	Graduate	1.16 (0.33- 4.01)	0.819		
	Postgraduate	1.58 (0.45- 5.62)	0.477		
	PhD	1.13 (0.24- 5.37)	0.883		
Profession	Medical doctor	1.00			
	Microbiologist	2.115 (0.42 - 10.7)	0.365	2.16 (0.43 - 10.94)	0.354
	Pharmacist	1.154 (0.43 - 3.13)	0.779	1.15 (0.42 - 3.12)	0.788

	Dentist	1.54 (0.16 - 14.90)	0.71	1.57 (0.16 - 15.33)	0.696
	Nurse	**0.10 (0.01 - 0.931)**	**0.043**	0.11 (0.01 - 1.09)	0.06
	Environmental officer	0.39 (0.05 - 2.98)	0.361	0.435 (0.06 - 3.47)	0.432
	Agricultural officer	0 (0 - .)	1	0 (0 - .)	1
	Other	0.769 (0.07 - 9.12)	0.835	0.77 (0.06 - 9.17)	0.835
	Veterinary doctor	0.77 (0.075 - 9.12)	0.835	0.77 (0.06 - 9.17)	0.835
	Laboratory scientist	**0.27 (0.09 - 0.84)**	**0.023**	**0.27 (0.09 - 0.86)**	**0.026**

Note: AOR, Adjusted Odds ratio; COR, Crude Odds ratio and CI, confidence interval. The variables in bold are significantly associated with knowledge.

Discussion

The importance of combating AMR has been recognised globally, with organisations such as the WHO advocating for comprehensive strategies (25,26). The United Republic of Tanzania recently launched its Second NAP on AMR for 2023-2028 (27), underscoring the urgency of coordinated efforts to combat this growing threat (27). The plan aims to provide a strategic framework for guiding interventions and actions to mitigate AMR across various sectors led by teams of healthcare workers. Studies on AMR-related KAP contribute to the global discourse on AMR and provide valuable perspectives for designing effective interventions (28). Therefore, we investigated the knowledge, practices, and attitudes of healthcare workers in Tanzania regarding their level of understanding of AMR and AMU, as well as the factors influencing their prescription tendencies.

Participants reported diverse sources of information on AMR and AMU, with the WHO guidelines (21.4%, n = 71) and national guidelines (20.2%, n = 67) being the most frequently cited. The prominence of these sources highlights the value of both global and locally adapted recommendations in guiding clinical decision-making. Internet resources (20.2%, n = 67) were also widely used, reflecting the increasing reliance on digital platforms for health information, although this raises concerns about the quality and reliability of online content. Previous training and professional experience (17.8%, n = 25) were further emphasised, underscoring the importance of continuous professional development in reinforcing stewardship practices. Similar findings have been reported among healthcare providers in Bangladesh (29) and Bhutan (30), suggesting that structured training is a consistent driver of AMR-related knowledge across different contexts.

Microbiologists were cited by 10.2% (n = 34) of the participants as essential sources of expertise, reflecting their critical role in providing insights into microbial pathogens and resistance mechanisms (30,31). Peer-to-peer learning was also highlighted by 7.2% (n = 24) of the participants, underscoring the value of interprofessional collaboration and knowledge exchange in clinical decision-making. These findings support broader calls for integrating interprofessional practice (IPP) into healthcare systems to strengthen antimicrobial stewardship (30). A small proportion (3.0%, n = 10) reported that pharmaceutical companies were sources of AMR and AMU information mainly through online platforms and sponsored channels. While this illustrates the reach of industry-driven knowledge dissemination, it also highlights the need for strict regulations to ensure accuracy and safeguard against promotional bias (32–34). The main factors influencing prescribing decisions were the local availability of antimicrobials, concerns about the potential rise of resistant bacteria, and the client's economic status. Moderately influential factors included the route of administration, culture and susceptibility results, organism or disease type, and a patient's previous AMU history, reflecting their role in guiding rational prescribing. In contrast, clinical signs, guideline recommendations, and drug instructions were rated as less influential, suggesting that decision-making often prioritises access and clinical pragmatism over standardised guidance. These findings highlight the multifaceted nature of antimicrobial prescribing and the challenge of striking a balance between clinical judgment and stewardship principles. Similar influences on prescribing behaviour have been observed in other LMIC settings (32,35,36). Understanding these drivers is critical for designing evidence-based, locally relevant interventions to optimise stewardship, reduce inappropriate prescribing, and limit the emergence of resistance (37–39).

Respondents reported relatively good knowledge in areas such as interpreting microbiological results, selecting routes of antimicrobial administration, choosing correct dosages, and identifying classes and generations of antibiotics, with most rating their knowledge as medium to good. In contrast, awareness was notably lower for Tanzania's NAP on AMR and for the WHO-designated reserve group of antimicrobials (40,41). This gap is concerning because the NAP on AMR 2023–2028 was developed to strengthen multisectoral efforts against resistance, with a central focus on raising awareness and improving healthcare providers' knowledge through education and communication strategies. Similarly, the WHO's reserve list identifies last-resort antibiotics for multidrug-resistant infections, where misuse could severely undermine global treatment options (42). These findings suggest a critical need to embed NAP on AMR priorities into professional training and ensure that frontline providers are aware of stewardship responsibilities concerning last-resort antibiotics.

The respondents strongly linked the problem of AMR to the inappropriate use of antibiotics in animals and humans. Additionally, most respondents supported imposing restrictions on antibiotic usage and prioritising antibiotics for human use. However, other statements had more varied opinions. For instance, respondents had mixed views on whether AMR is natural or anthropogenic. Similarly, there were varying responses regarding the extent to which a single course of antibiotics could cause AMR. The respondents expressed confidence in the availability of sufficient sources of information on antimicrobials and their usage, with one-third agreeing and nearly one-fifth disagreeing. Understanding these perspectives on the perceptions and attitudes of healthcare workers is crucial for developing targeted interventions and educational initiatives to address the challenges posed by AMR and to promote responsible AMU (30).

Respondents widely recognised inappropriate antibiotic use in both humans and animals as a major driver of AMR, and most supported restrictions on antibiotic access to safeguard agents prioritised for human health. However, attitudes were more divided based on specific issues. Some participants viewed AMR as a natural phenomenon, whereas others attributed it primarily to human behaviour. Opinions also vary regarding the extent to which a single antibiotic course contributes to resistance. Confidence in the adequacy of available information was similarly mixed, with about one-third of the respondents agreeing that sufficient resources exist and nearly one-fifth disagreeing. These findings highlight the persistence of misconceptions alongside accurate perceptions, suggesting that targeted educational interventions are needed to clarify the origins of AMR and reinforce evidence-based stewardship practices. Addressing such gaps in attitudes is critical for building a workforce that consistently applies rational AMU principles in practice (30).

A significant negative correlation was observed between practice and attitude scores, indicating that stronger attitudes toward AMR do not always translate into corresponding prescribing practices. This discrepancy suggests that improving stewardship requires more than isolated gains in knowledge or attitudes; meaningful change depends on integrating these domains into daily clinical decision-making (36). Such misalignment has been documented in other contexts, where favourable attitudes and prior training were associated with higher knowledge but not consistently with practice (43,44). These findings underscore the challenge of translating awareness into behaviour and highlight the need for interventions that combine education, skill building, and system-level support to foster rational antibiotic prescribing.

Nurses and laboratory scientists demonstrated significantly lower levels of AMR/AMU knowledge compared to doctors, even after accounting for gender. This highlights how professional background shapes knowledge levels and suggests that tailored capacity-building efforts are needed for these groups (37–39,44). Such disparities are important because inadequate knowledge and attitudes have been linked to inappropriate prescribing and dispensing, which increases the risk of antibiotic misuse and resistance (20,45). Therefore, strengthening training and professional development across all cadres is critical for advancing antimicrobial stewardship.

Study limitations

This study had some limitations. First, recruiting participants mainly from a scientific conference and AMR workshop may have introduced selection bias, as attendees are likely to be more knowledgeable and engaged with AMR issues than the general healthcare workforce in Tanzania. This may have led to an overestimation of the awareness of and commitment to antimicrobial stewardship. Second, the use of self-reported questionnaires could be subject to recall and social desirability bias. Third, the cross-sectional design limits causal inferences. Nonetheless, these findings provide valuable baseline insights into future AMR interventions in Tanzania.

Conclusion

This study demonstrates that while Tanzanian healthcare providers exhibit moderate to high knowledge of AMU, significant gaps remain in their awareness of national and global AMR strategies. The negative association of knowledge with professional groups, such as nurses and laboratory scientists, suggests that interventions should be tailored to specific cadres. Strengthening continuous education, diagnostic capacity, and locally relevant stewardship interventions is essential to optimise antimicrobial prescribing, mitigate AMR risks, and improve patient outcomes.

Abbreviations

AMR: Antimicrobial Resistance
AMU: Antimicrobial Use
AOR: Adjusted Odds Ratio
CI: Confidence Interval
COR: Crude Odds Ratio
GLASS: Global Antimicrobial Resistance Surveillance System
HIV/AIDS: Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IPP: Interprofessional Practice
KAP: Knowledge, Attitudes, and Practices
LMIC: Low- and Middle-Income Country
MDR: Multidrug-Resistant
MUHAS: Muhimbili University of Health and Allied Sciences
NAP: National Action Plan
REC: Research Ethics Committee
SD: Standard Deviation
SPSS: Statistical Package for the Social Sciences
UI: Uncertainty Interval
USD: United States Dollar
WHO: World Health Organization

Author contributions statement

RZ, HN, and MI were involved in creating the study protocol, and TM and HN were involved in data collection. RZ, MM, AJ and DK performed statistical analysis and data interpretation; NS, AJ, MM and TM were involved in preliminary data design and assessment and literature review. MM, RZ and drafted the manuscript. NS, MM, AJ and DK gave a critical revision of the manuscript. All authors have read and approved the final manuscript.

Acknowledgments

We would like to acknowledge the support from the Muhimbili University of Health and Allied Sciences (MUHAS) and the organisers of the 11th MUHAS Scientific Conference on Antimicrobial Resistance (AMR).

Data availability statement

The raw data for the study are available upon request from the corresponding author.

Disclosure

The authors (s) report no conflicts of interest.

Funding

No funding was received for this study.

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