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Knowledge, attitudes and practices of veterinarians and para-veterinarians towards antimicrobial stewardship in Malawi: underutilized strength in the fight against antimicrobial resistance

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Abstract

Antimicrobial resistance (AMR) is a global public health concern, and the inappropriate use of antibiotics in animals and humans is considered a significant contributing factor. Para-veterinarians and veterinarians are vital in the fight against AMR. The study aimed to evaluate the knowledge, attitudes and practices of the para-veterinarians and veterinarians towards antimicrobial stewardship in Malawi. A cross-sectional questionnaire survey among the para-veterinarians and veterinarians was conducted from October 2024 to January 2025. A total of 69 participants, comprised of 42 para-veterinarians and 27 veterinarians, participated in this study, and the response rate for the survey was 44% ($n=158$). The study used a predetermined cutoff of ≥ 55% to classify scores as having good knowledge, good practice, and a positive attitude. The study found that 85.5% of the respondents had good knowledge and 98.6% had good practices towards antimicrobial stewardship and prevention of AMR, while 92.8% had favorable attitude towards AMR and antimicrobial stewardship. The maximum obtainable scores for each construct were 11, 13 and 13 for knowledge, practice, and attitude, respectively. The overall mean scores for knowledge, practice and attitude were 11.25 ± 2.83, 8.71 ± 1.34 and 9.04 ± 1.64, respectively. These findings indicated that the respondents had good knowledge, good practices and favorable positive attitude towards AMR and antimicrobial stewardship. The study concludes that there is good level of knowledge, practice and favorable attitude among para-veterinarians and veterinarians towards antimicrobial stewardship which can be capitalized in the fight against AMR in Malawi. The veterinary professionals can be entrusted to comply with responsible antimicrobial prescriptions and use.

Keywords Antimicrobial resistance, Antimicrobial stewardship, KAP, Veterinary professionals, Para-veterinarians, Veterinarians

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Introduction

Resistance to antimicrobials is rising globally, threatening the ability to treat common infectious diseases of animals and humans [1, 2]. Antimicrobial resistance (AMR) is a worldwide public health concern, and the inappropriate use of antibiotics in animals and humans is a major contributing factor [3–5]. Previous surveys applied to livestock products [6–10], drug vendors [11–12], and the general public [13–15] have exposed suboptimal understanding of AMR as evidenced by the indiscriminate, overuse and misuse of antimicrobials in livestock production and human health. A frightening report on AMR from the United Nations World Health Organization (WHO) and other sister global health agencies warned about the rise of multidrug-resistant (MDR) pathogens. The report suggested that drug-resistant infections could cause approximately 10 million deaths each year by 2050 and result in disastrous economic damage similar to the 2008– 2009 global financial crisis. Further, the report indicated that by 2030, antimicrobial resistance (AMR) could have forced up to 24 million people into extreme poverty [16, 17]. Subsequent to dwindling reports of antibiotic options available for the control of emerging, life-threatening and multidrug-resistant bacteria, there is a need for proper antibiotic stewardship to preserve the efficacy of existing antibiotics [3, 18, 19].

The emergence and spread of AMR occur mostly through natural means, and through increased selection pressure that produces superbugs, due to injudicious use of antimicrobials in both human and animal medicine [20, 21]. Livestock production coupled with weak policies on antimicrobial use, has increased in most developing countries [22]. Farmers use sub-therapeutic (non-effective) doses in animal feeds to enhance growth, prevent diseases, and increase productivity [23]. Antimicrobial use (AMU) is under serious abuse in the livestock industry, especially in the commercial sector across the world and is perpetuated by the desire for higher livestock production, which accounts for higher concentrations of antimicrobial residues [24–27]. Veterinary antimicrobial residues may affect human health both directly and indirectly.

Despite the consequences and challenges associated with AMR, many countries in sub-Saharan Africa have not scaled up actions to meet the expected level of control efforts on rates of usage of antimicrobials in livestock production and food systems [3]. Surveillance for resistant organisms and implementation of the global and national action plans on AMR is rudimentary in most of these countries [3, 18, 28]. The political will, especially meeting the cost of policy implementation, often serves as a major limitation to the implementation of such programmes [3]. In addition, it is expected that the veterinary and medical institutions focus on relevant training to meet the current AMR needs and prevent future resistance-related problems. It is also expected that the next generation of veterinary and human doctors, together with the environmental health experts, should be capable of prudently using antimicrobial agents if we are to curb the surge of AMR in sub-Saharan Africa [29, 30]. It is imperative to adopt one health approach when monitoring animal health activities and ensure that all sectors are providing the huge mentorship role to the current and the next generation of professionals in curbing indiscriminate AMU and AMR [31, 32].

In Malawi, surveillance programs for antimicrobial use and AMR in humans and animals are in their infancy, and the human and animal healthcare sectors at ministry levels tend to work in silo, resulting in a lack of intersectoral collaboration [12]. Additionally, in Malawi, the lack of regulation of existing veterinary drug markets and low involvement of pharmacists [12] and veterinarians in the formal drug distribution market [12] may possibly contribute to the issue of substandard drugs in the marketplaces and inappropriate use of antimicrobials. It is well accepted in other countries that pet and livestock owners should access veterinary drugs upon acquiring a written prescription from veterinarians, which is yet to be adopted in Malawi [3, 12, 33]. Owing to these, there is easy access to veterinary antimicrobials by pet and livestock owners, which are administered at the owner's discretion, a behavior that exacerbates the consequences of AMR on livestock production, animal health, and human health [3, 7]. Among the drivers of easy access to veterinary antimicrobials is lack of requirement or regulation for acquiring prescription before visiting veterinary drug shops. Additionally, many pet and livestock owners masquerade as community animal health workers (CAHW) and give impression of being knowledgeable on veterinary antimicrobials [12]. Oftentimes, drug shop owners do not ask for prescription from potential buyers. This situation gives rise to two dreadful consequences (1) any-one buys antibiotics without the proper check on how the drug will be used; (2) the drug shop owner takes advantage of any client who walks into the shop by recommending any available antibiotic to make business. This situation is likely to initiate the selling of counterfeit and expired drugs at affordable prices by scrupulous drug shop owners and contribute to AMR [34].

Despite the negative impact of AMR on animal and human health, livestock production, plant, environment and their ecosystem, there remains a paucity of data concerning the knowledge of AMR among the para-veterinarians and veterinarians in Malawi to warrant them to assume the responsibility of issuing prescriptions [12]. More importantly, it is unclear if empowering para-veterinarians and veterinarians to issue prescription for every veterinary product before sale has potential to limit easy

access to antibiotics, subsequently prevent the injudicious use of antibiotics in animals in Malawi. Essentially, para-veterinarians and veterinarians are expected to be responsible for prescribing and overseeing antimicrobial use in animals [35]. The expected positive behavior of para-veterinarians and veterinarians are typically dependent on their level of knowledge, practice and attitude, the existing policies and the National AMR strategy to scale-up the fight against AMR in animals for better health of the humans, environment and their ecosystem. Therefore, the role of the para-veterinarians and veterinarians in tackling AMR cannot be over-emphasized as they are the custodians of antimicrobials used in veterinary practice [36–37]. The KAP of para-veterinarians and veterinarians towards antibiotic use, resistance, and factors influencing the prescribing behavior of veterinarians remains speculative. Hence, the study explored the KAP of the para-veterinarians and veterinarians in Malawi regarding antibiotic use and resistance and their potential to safeguard the easy access of antibiotics. To the best of our knowledge, this is the first antibiotic KAP study among the registered members of the Veterinary Assistants Association of Malawi (VAAM) and Malawi Veterinary Association (MVA).

Materials and methods

Study site and design

A cross-sectional study was conducted in all three regions of Malawi, namely Northern, Central and Southern, in the period of October 2024 to January 2025. These regions constitute the geographical distribution of livestock farming and the associated sources of veterinary services in the country (Fig. 1). In Malawi, agriculture is the mainstay of the economy, and livestock production is the primary source of animal-origin food for humans. Poultry, cattle, goats, sheep and pigs are the major food animals produced under commercial or subsistence agriculture across the country.

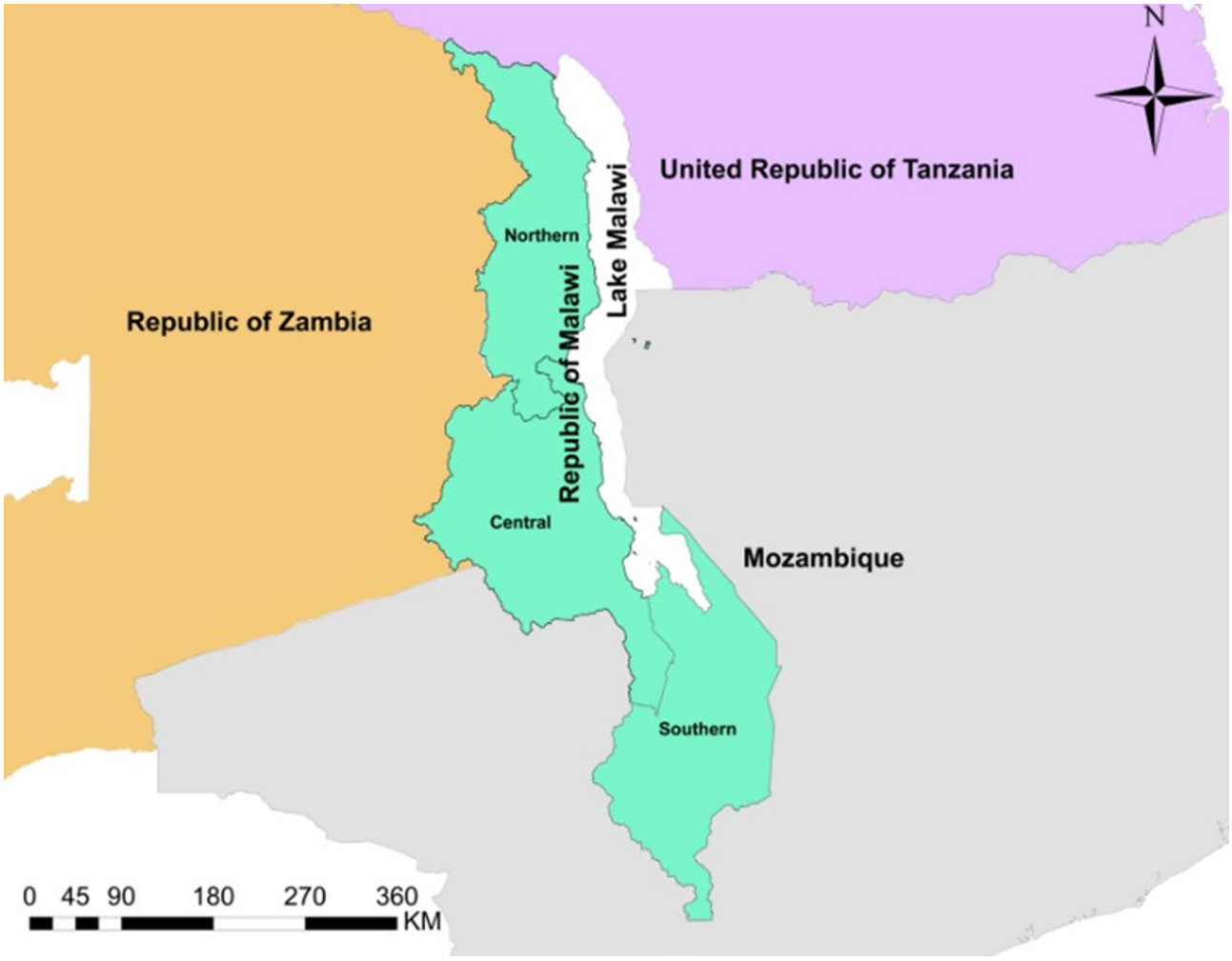

Fig. 1 Map of Malawi showing the three regions where the study was conducted

Sample size

The records from MVA and VAAM secretariat showed that Malawi had 171 para-veterinarians and 96 veterinarians, respectively were duly registered [38] and were used to estimate the sample size. Assuming a known target population of 267, margin of error as 5%, confidence level as 95%, and response distribution as 50%, a total of 158 participants was estimated for this study. This was then proportionally distributed at a ratio of 1:2 among the veterinarians and the para-veterinarians, respectively. The study randomly selected 118 para-veterinarians and 40 veterinarians from VAAM and MVA register books, respectively from secretariats in September, 2024. The participants were identified through generation of random numbers by Microsoft™ Excel Spreadsheet (Microsoft Office Ex- cel®2019). The overall response rate/participation acceptance was 44%.

Study design, respondents recruitment and data collection

A cross-sectional survey was conducted in para-veterinarians and veterinarians in Malawi. The questionnaire was prepared and reviewed by specialist para-veterinarians and veterinarians. The structure and content of the survey were based on those used in previously conducted studies [33, 39–41] and were adapted to our setting based on discussions with experts in para-veterinary and veterinary practice at MVA and VAAM, respectively. The questionnaire was pre-validated for objectivity, relevance, accuracy, clarity, simplicity, and understandability by a team of experts at Lilongwe University of Agriculture and Natural Resources (LUANAR), Department of Animal Health and Livestock Development (DAHLD), Central Veterinary Laboratory (CVL), MVA and VAAM [33, 42]. Before data collection, content validity of the questionnaire was discussed among these experts to assess conformity of the questionnaire to the study objective and to obtain consensus, internal consistency and reliability of the study instrument. A pilot study of the questionnaire was administered to 5 para-veterinarians and 5 veterinarians that were excluded from the final analysis. The observed weaknesses were improved. Records of registered para-veterinarians and veterinarians including their contact details were obtained from MVA and VAAM, respectively. The questionnaire had four sections and the first section collected information related to demographic data including age, gender, work experience, veterinary practice and employment status. The second section seek obtain the knowledge of participants about antimicrobial use. The third section collected information on practices that participants conducted towards choice and usage of antimicrobials. The last section collected attitude of participants towards AMR, assessed using a scale of: 'agree', 'neutral', and 'disagree'. The four sections provided the understanding of the participants towards antimicrobial use and resistance (S1 File). A complete designed structured questionnaire with both open and closed questions was captured onto *SurveyMonkey* (SurveyMonkey Inc., San Mateo, California, USA) by the principal investigator.

Thereafter, the self-administered questionnaire was sent to the sampled registered para-veterinarians and veterinarians using details obtained from the register book. Data was collected from 27 veterinarians and 42 para-veterinarians from both private and public veterinary service providers. Practices on antimicrobial use and resistance was tested through 10 questions while knowledge had 13 and attitude was tested through 11 questions that could be answered "yes" "agree", "no" or "unsure/don`t know/disagree". These questions were statements, all of which had a correct answer based on the most current biomedical knowledge. Scores for knowledge, attitude, and practice were calculated by adding correct/positive responses (given as 1 for correct/positive response, and otherwise zero) as previously reported by [41–44]. The "knowledge score", "attitude score", and "practices score" for each respondent were calculated based on the number of correct answers given, from which category overall mean was calculated [45]. Thereafter, the overall mean score above 75% of the total number of questions for each category (7.5 for practice, 9.75 for knowledge and 8.25 for attitude) was regarded good and acceptable knowledge, practice and favorable attitude towards AMR and antimicrobial stewardship. The maximum obtainable score for each construct were 11, 13 and 13 for knowledge, practice, and attitude, respectively.

Study variables and measurement

Acceptable knowledge, practice, and a positive attitude about AMR and antimicrobial stewardship were the study's primary outcome variables. The sociodemographic factors were assessed for connection to AMR and antimicrobial stewardship.

Data processing, analysis and interpretation

Data were cleaned and validated in Microsoft™ Excel Spreadsheet (Microsoft Office Ex- cel®2019, where scores of each component were calculated. Data analysis was conducted using SPSS Ver. 21 (IBM Corp, Armonk, NY, USA) statistical software. Characteristics and other variables related to the respondents were analyzed using descriptive statistics and presented as mean, percentages and proportions with 95% confidence intervals. Mean knowledge, attitude and practice scores and demographic characteristics were compared using *t*-tests. Chi-square tests were conducted to test for differences in responses between para-veterinarians and veterinarians' knowledge, practice and attitude scores [12, 41]. All respondents were categorized based on the mean score of 55%,

following the method used in similar studies on categorization [46, 47]. The low knowledge categories (mean and below) were those who scored 0– 55%, and the good knowledge (above mean) were those who scored 56– 100%. Similar decision cut off score was applied to practice and attitude and 55% was selected to cover the possible gaps between the para-veterinarians and veterinarians which would influence the overall mean scores as previously applied [48, 49].

Results

Socio-demographic information of the study respondents

Out of the 69 respondents, males were 62.3% (43/69) while females were 37.7% (26/69). Most of the respondents were aged below 40 years, 88.4% (61/69), while those respondents with an age above 40 years were 11.6% (8/69). The respondents were drawn from all possible levels of academic achievements such that the diploma holders were in majority 60.9% (42/69) followed by bachelor`s degree holders 26.1% (18/69) followed by the master degree holders 11.6% (8/69) and the PhD holders were the least 1.4% (1/69) (Table 1).

Common infectious agents

The respondents indicated that bacterial infections were the most commonly encountered conditions 64.2% (217/338) followed by viral infections 16.9% (57/338), then parasitic infections 14.5% (49/338) and fungal infections were the least 4.4% (15/338) (calculated based on the number of diseases provided by respondents and not on sample size) Fig. 2.

Respondents' knowledge on antimicrobial use and resistance

The majority of the respondents 81.2% (56/69) knew that antibiotics kill bacteria and the knowledge was significantly different between para-veterinarians and veterinarians ($p = 0.001$). Most of the respondents knew that antibiotics do not kill viruses 97.1% (67/69). Majority of respondents knew that overuse of antibiotics facilitates development of resistant organisms and there was a significant difference in knowledge between the para-veterinarians and veterinarians ($p = 0.005$). Additionally, a large portion of the respondents, 89.9% (62/69), knew what AMR and antibiotic stewardship are, and the knowledge was significantly different between the veterinarians and para-veterinarians ($p = 0.037$). The majority of the respondents, 92.8% (64/69) knew that withdrawal period

Table 1 Summary of socio-demographic characteristics of respondents

Variable	Category	Frequency	Proportion (%) $n = 69$	95% CI
Gender				
	Male	43	62.3	49.8–73.5
	Female	26	37.7	26.5–50.2
Age (years)				
	18–40	61	88.4	77.9–94.5
	≥ 40	8	11.6	5.5–22.1
Education				
	Diploma in Animal health or Veterinary Science	42	60.9	48.3–72.1
	Veterinary degree (DVM, etc.)	18	26.1	16.7–38.3
	MSc/MPH	8	11.6	5.5–22.1
	PhD	1	1.4	0.0-8.8
Work experience				
	≤ 5 years	32	46.4	34.4–58.7
	≥ 5 years	37	53.7	41.2–65.5
Employment Status				
	Government employee	48	69.6	57.2–79.7
	Non-governmental organization employee	3	4.3	1.1–13.0
	Private practice	15	21.8	13.0-33.6
	Teaching	3	4.3	1.1–13.0
Veterinary Practice				
	Mixed practice (large, small or exotic animals)	52	75.5	63.3–84.6
	Large and small animals, including poultry	9	13.1	6.5–23.8
	Laboratory diagnosis, research and investigation	1	1.4	0.0-8.8
	Small animal practice (dogs, cats, rabbits)	3	4.3	1.1–13.0
	Wildlife practice (wild animals)	1	1.4	0.0-8.8
	Work on regulation as a government officer, not practicing in a specific area	3	4.3	1.1–13.0

n = Number of respondents; CI = 95% Confidence Interval

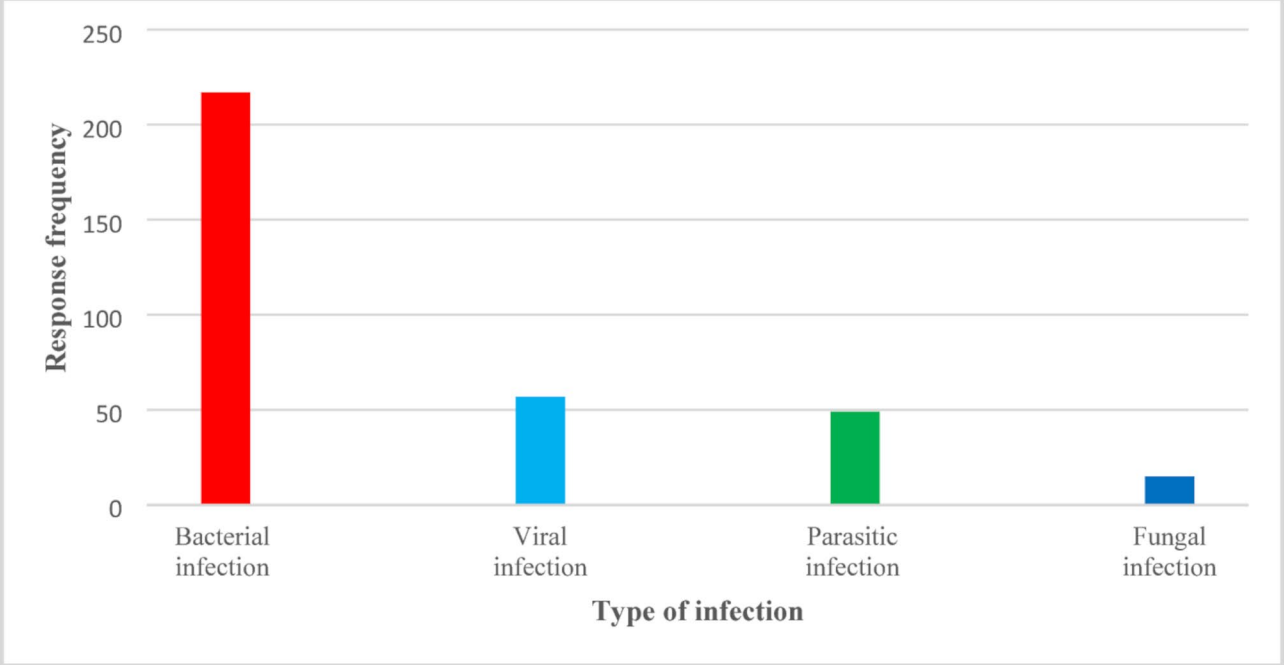

Fig. 2 Common infectious agents managed within the last five years

Table 2 The proportion of respondents who correctly / positively responded to knowledge questions on antimicrobial use and resistance across the study area

Knowledge questions	Respondents' specialty		*p*-Value	Total (*n* = 69) (%)
	Vets (*n* = 27)	Para-vets (*n* = 42)		
Antibiotics kill or stop the growth of both good and bad bacteria? *True*	26 (96.3)	30 (71.4)	0.001*	56 (81.2)
Antibiotics kill viruses? *False*	26 (96.3)	41 (97.6)	0.752	67 (97.1)
Overuse of antibiotics makes them become ineffective? *True*	26 (96.3)	30 (71.4)	0.001*	56 (81.2)
Do you know antimicrobial resistance? *Yes*	27 (100)	35 (83.3)	0.037*[a]	62 (89.9)
Bacteria can become resistant to antibiotics. *True*	26 (96.3)	34 (80.9)	0.010*[a]	60 (87)
In what microbes is antibiotic resistance a major problem? *Bacteria*	26 (96.3)	34 (80.9)	0.010*[a]	60 (87)
Healthy people and animals can carry antibiotic resistant bacteria. *Agree*	26 (96.3)	38 (90.5)	0.149	64 (92.8)
Do you know overuse of antibiotics can lead to development of resistant organisms? *Agree*	26 (96.3)	33 (78.6)	0.005*[a]	59 (85.5)
A withdrawal period does not have to be observed for food animals treated with antibiotics such as penicillin and tetracycline before they can be consumed *Disagree*	26 (96.3)	38 (90.5)	0.148	64 (92.8)
A withdrawal period has to be strictly observed in treated poultry before any poultry product is passed as fit for human consumption. *Agree*	26 (96.3)	33 (78.6)	0.005*[a]	59 (85.5)
Do you know the term "antibiotic stewardship"? *Yes*	27 (100)	35 (83.3)	0.037*[a]	62 (89.9)
Do you know the National AMR strategy? *Yes*	24 (88.9)	36 (85.7)	0.466	60 (87.0)
Are you aware of the critically important list of antimicrobials according to the WHO? *Yes*	21 (77.8)	26 (61.9)	0.394	47 (68.1)

n = number of respondents; % = Percentage; * Indicates statistically significance difference at $p < 0.05$; [a] = Fisher's exact test

is critical in food animals treated with penicillin and tetracycline (as the most commonly used antibiotics in livestock in Malawi). Additionally, most of the respondents 87% (60/69) were aware of the National AMR strategic Plan (Table 2).

Respondents` practices regarding antimicrobial use and resistance

The majority of respondents 94.2% (65/69), reported relying on microbiological culture and sensitivity, along with empirical treatment, while awaiting microbiological culture and sensitivity (MCS) results. Additionally, more than three-quarters of the respondents, 84.1% (58/69), confirmed undertaking antimicrobial sensitivity testing before initiating antibiotic treatment. Further, most of

the participants, 91.3% (63/69), attributed their selection of antibiotics to veterinary education.

Moreover, a significant number of respondents, 87.0% (60/69), depend on the internet for additional information on antibiotic use. Notably, veterinarians 96.3% (26/27) were more influenced by the client's ability to pay for the drug compared to para-veterinarians 83.3% (35/42) ($p = 0.037$). Further, most of the respondents, 81.2% (56/69), considered sensitivity results/antibiogram as the most critical characteristic when selecting antibiotics, with veterinarians demonstrating a better understanding of this practice compared to para-veterinarians ($p = 0.005$) (Table 3).

Respondents' attitude regarding dispensing of antimicrobial medicine

Three-quarters of the respondents, 78.3% (54/69), disagree with the perception of using prophylactic antibiotics as an appropriate alternative to protect animal health when there is poor biosecurity. The majority of the respondents, 94.2% (65/69), considered antibiotic resistance a national problem. A similar proportion, 94.2% (65/69), also believed that prescribing unnecessary antibiotics is professionally unethical. Additionally, most of the respondents, 95.7% (66/69), believed that veterinarians have a role to play in preventing public health threats posed by antibiotic resistance. Further, a greater proportion, 95.7% (66/69), believed that antibiotic resistance would be a greater problem later in their career than it is today. Of the 69 respondents, two-thirds of the participants, 65.2% (45/69), regarded climate change as an important challenge in the world today (Table 4; Fig. 3). Excessive use of antibiotics in livestock and food production was noted as the potential contributor to antibiotic resistance in the study, 68.1% (47/69) (Table 4; Fig. 4).

Over half of the respondents, 56.5% (39/69), recommended that the government must formulate better guidelines on antibacterial use in Malawi (Table 4; Fig. 5).

Mean knowledge, attitude, and practices across the socio-demographic characteristics

The study found the mean knowledge, practice and attitude between sexes as similar. The mean practice of the 18–40 age group was higher than the mean for the ≥ 40 age group ($p = 0.007$). The mean knowledge, practice and attitude for education level was significantly different across the categories (Table 5).

Distribution of respondents` KAP scores across the categories

Good scores were obtained by respondents across the three categories, such that 85.5% (59/69) was the score for knowledge and 98.6% (68/69) was score for the practices, while score for attitude was 92.8% (64/69) (Table 6).

Discussion

A good veterinary service can curb the non-prudent use of veterinary products, antibiotics [2, 3]. The fight against AMR and poor antimicrobial stewardship requires competent veterinary service globally, including Malawi [1]. This study reports good knowledge, good practice and positive attitude among the para-veterinarians and veterinarians towards AMR and antimicrobial stewardship, an underutilized strength in the fight against AMR in Malawi. The current study shows that the majority of para-veterinarians and veterinarians are aware of the threat of AMR towards their future career, such that antibiotics will work less well in future if poorly prescribed now, as reported elsewhere [7, 27, 45, 46].

Participants of the current study reported that excessive use of antibiotics in livestock and food production is a significant contributor to antibiotic resistance, which is in accordance with reports from previous studies [24–27]. In the study, bacteria are the leading infectious disease agents that attract the use of antibiotics, even though viral infections can also be attended with using antibiotics. In all situations, prudent and proper choice of antibiotics cannot be ignored and competent veterinary service is imperative for meaningful prescription of antibiotics, as reported previously [12, 43]. Subsequently, the majority of the respondents recommended that the government must formulate better guidelines on antibacterial use in Malawi that include empowering registered para-veterinarians and veterinarians to provide antibiotic prescriptions, which might reduce unregulated access to antibiotics as previously reported [12].

The observed differences in scores of knowledge, practice and attitude between para-veterinarians and veterinarians indicate the existing gaps between the two, as the degree program materials are different to diploma program materials in terms of lecture materials for AMR [45, 50]. The ability to articulate the progress of cases and provide quality veterinary services is supported with the level of qualification, knowledge and skills, as also reported in Abuja, Nigeria [51]. Further, the previous observation aligns with the results that veterinarians' decision on choice of antibiotic is influenced by the cost of the antibiotic, which in particular, is the drug of interest in the management of the bacterial case at hand [3, 7, 52, 53]. This suggests that the quality of veterinary service might be different between the para-veterinarians and veterinarians. The existing gap suggests the need to indicate categorically the drugs to be prescribed by para-veterinarians and those drugs to be prescribed by veterinarians.

The overall mean knowledge, attitude, and practice scores across socio-demographic characteristics were higher for knowledge and attitude but low for practice. The education category results were significantly

Table 3 The proportion of respondents who correctly/positively responded to practices questions regarding antimicrobial usage and resistance across the study area

Practice questions	Respondents' specialty		*p*-Value	Total (*n* = 69) (%)
	Vets (*n* = 27)	Para-vets (*n* = 42)		
When a patient is presented for the first time and antibiotics are indicated, what guidelines do you follow to help you select the appropriate antibiotic? *Microbiological culture and sensitivity (MCS) testing and Empirical treatment whilst awaiting MCS result*	26 (96.3)	39 (92.9)	0.150	65 (94.2)
How often do you undertake antimicrobial sensitivity testing before starting antibiotic treatment? *Sometimes (1–3 times a month), Frequently (more than 3 times a month), Always*	25 (92.6)	33 (78.6)	0.181	58 (84.1)
Which ONE of the following is the most important factor that influences your decision when requesting antimicrobial sensitivity testing? *Poor response to initial antimicrobial therapy or therapeutic failure, Recurrent conditions*	25 (92.6)	34 (80.9)	0.080	59 (85.5)
Of the following barriers to using antimicrobial sensitivity testing, which barriers do you consider the most important? *Owner unable or not willing to pay for culture and sensitivity testing*	26 (96.3)	32 (76.2)	0.900	58 (84.1)
Which ONE of the following guidelines is the most important factor that influences your decision when selecting an antibiotic to use? *Veterinary education/training*	25 (92.6)	38 (90.5)	0.642	63 (91.3)
Do you provide prescriptions on antibiotic use to other veterinary service providers? *Yes*	27 (100.0)	37 (88.1)	0.148	64 (92.8)
Which ONE of the following past experiences influence your decision the most important when selecting an antibiotic to use? *My own previous experience*	23 (85.2)	34 (80.9)	0.400	57 (82.6)
Which ONE of the following is the most important factor that influences your decision when selecting an antibiotic to use? *Owner ability to pay*	26 (96.3)	35 (83.3)	0.037*	61 (88.4)
Of the following antibiotic characteristics, which one influence your decision the most important when selecting an antibiotic to use? *Sensitivity results/ antibiogram*	27 (100.0)	29 (69.0)	0.005*	56 (81.2)
What are the information sources that you use in your daily work endeavors when you want information on antibiotic use and antimicrobial resistance? Suggest the one that apply, *Internet*	25 (92.6)	35 (83.3)	0.466	60 (87.0)

n = number of respondents; % = Percentage. * Indicates statistically significant at $p < 0.05$

different across the academic levels, which corroborates our discussion above and the study conducted in South Africa and Nigeria [45, 51]. Of interest is the mean score for the work experience, which indicates that knowledge, attitude, and practice towards antimicrobial stewardship and AMU depend not on experience but continuous professional development and information updates through sources like internet materials, as previously reported in many developing countries [3] and Jordan [53]. Similar observation was made on specialty, type of veterinary practice, sex and type of employment, which implies that there is a reliable body of veterinary professionals seemingly with capacity in AMU and antimicrobial stewardship that agreed with other reports [3, 54]. Further, the majority of the respondents suggested that prophylactic antibiotic use was not appropriate in situations where biosecurity was poor, which is not a common decision in developing countries that include Malawi, contrary to the reports made in India and Nigeria [44, 51]. The level of knowledge, practice and favorable attitude of the registered animal health workers suggested the available potential to provide the much-needed difference if given a chance to participate in the regulation of dispensing of antimicrobials by veterinary drug dispensers, including antibiotics. Further, the observed level of knowledge and practice might keep them motivated and influence a good attitude towards AMR and antimicrobial stewardship, subsequently impacting positive practice and attitude in veterinary drug dispensers, farmers and fellow but unregistered animal health workers as previously observed [3, 54].

Remarkably, the vast majority of participants acknowledged climate change as the world's most pressing issue because of the frequent natural disasters that Malawi faces, like cyclones Freddy, Ana, El Niño and drought, which decimate the nation's economy, including the livestock and agricultural sectors [55]. Nevertheless, the study has revealed the hidden strength in the fight against AMR in Malawi, which requires proper engagement of para-veterinarians and veterinarians in order to maximize their usage.

Limitations

The weakness of this study was the failure to capture similar information from unregistered para-veterinarians and veterinarians who are also providing similar services and could be equally entrusted with the responsibility to provide antimicrobial prescriptions (in the event that they decide to get registered). Secondly, data were collected using self-administered techniques, which could affect the validity of the data to some extent, as such outcomes depend on the truthfulness of the respondent. Lastly, the data is smaller than expected sample size due to attrition which was mainly due to majority don`t have email address while others is due to challenge to access internet in their locations. This applies more to para-veterinarians who operate in sub-urban and rural areas.

Conclusion

This study has revealed the prevailing strengths and weaknesses in knowledge, attitude and practices among registered para-veterinarians and veterinarians, a way of ascertaining their role in mitigating the AMR challenge through providing antimicrobial prescriptions to pet and livestock owners before they access the veterinary drug dispersers. There is good knowledge, practice and favorable attitude among para-veterinarians and veterinarians towards AMU and antimicrobial stewardship which can be a bedrock on which the fight against AMR can be built on in Malawi. The veterinary professionals can be entrusted to comply with responsible antimicrobial prescriptions and use.

Table 4 The proportion of respondents who correctly/positively responded to attitude questions regarding dispensing of antimicrobials across the study area

Attitude questions	Respondents' specialty		*p*-Value	Total (*n* = 69) (%)
	Vets (*n* = 27)	Para-vest (*n* = 42)		
In your opinion, which One of the following is the important challenge in the world today. *Climate change*	19 (70.4)	20 (47.6)	< 0.001*	45 (65.2)
Of the following potential contributors to antibiotic resistance, which one do you consider the most important. *Excessive use of antibiotics in livestock and food production*	23 (85.2)	24 (57.1)	0.133	47 (68.1)
When there is poor biosecurity, prophylactic antibiotics are an appropriate alternative to protect animal health. *Disagree*	23 (85.2)	31 (73.8)	0.074	54 (78.3)
Do you think that antibiotic resistance is a national problem? *Yes*	27 (100)	38 (90.5)	0.148	65 (94.2)
Do you think we still have more classes of antibiotics effective enough at the moment to keep up with the problem of resistance? *Yes*	24 (88.9)	23 (54.8)	0.001*	47 (68.1)
Do you feel veterinary services contribute towards antibiotic resistance problem? *Yes*	24 (88.9)	23 (54.8)	< 0.001*	47 (68.1)
Do veterinarians have a role to play in preventing public health threats posed by antibiotic resistance? *Yes*	27 (100)	39 (92.9)	0.148	66 (95.7)
Do you believe that prescribing unnecessary antibiotics is professionally unethical? *Yes*	26 (96.3)	39 (92.9)	0.148	65 (94.2)
In your own opinion, do you consider AMR as a challenge to your carrier? *Yes*	27 (100)	32 (76.2)	0.005*	59 (85.5)
Do you think that antibiotic resistance will be a greater problem later in your career than it is today? *Yes*	26 (96.3)	40 (95.2)	0.148	66 (95.7)
Do you feel you have sufficient knowledge on antibiotic use? *Yes*	26 (96.3)	21 (50.0)	< 0.001*	47 (68.1)
Do you believe that the antibiotics you prescribe without AST results may contribute to the problem of antibiotic resistance? *Yes*	26 (96.3)	35 (83.3)	0.136	61 (88.4)
Of the following recommendations for the use of antibiotics, provide the one you agree with? *Government must formulate better guidelines on antibacterial use for veterinary drugs*	14 (51.9)	25 (59.2)	0.613	39 (56.5)

n = number of respondents; % = Percentage. * Indicates statistically significant at $p < 0.05$

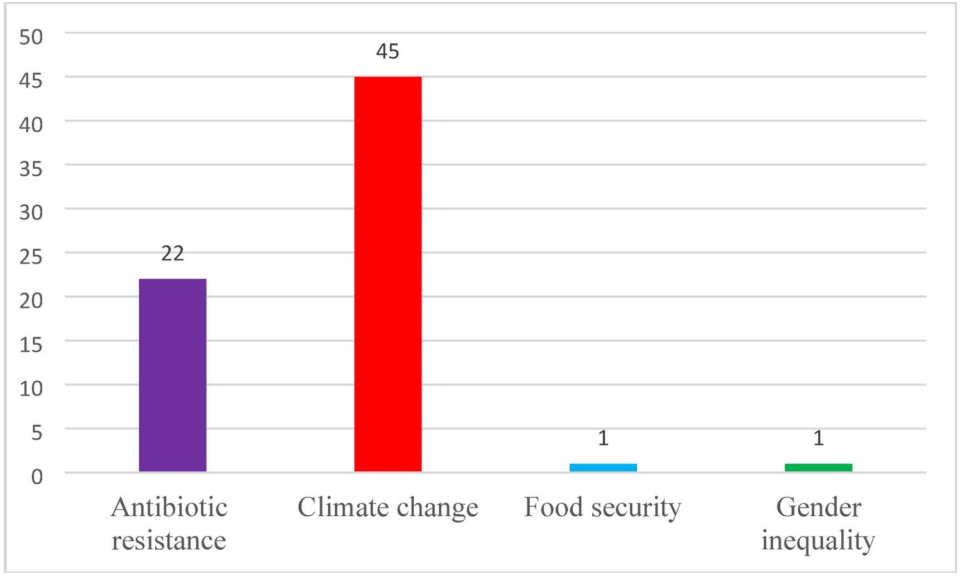

Fig. 3 Respondents' responses on important current world challenges

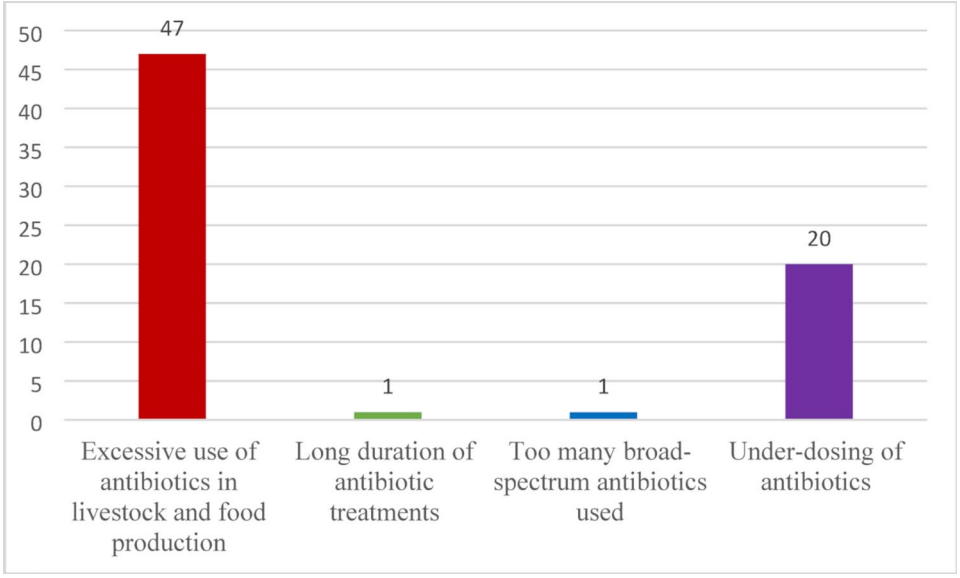

Fig. 4 Respondents' responses on the major contributors to the emergence of AMR

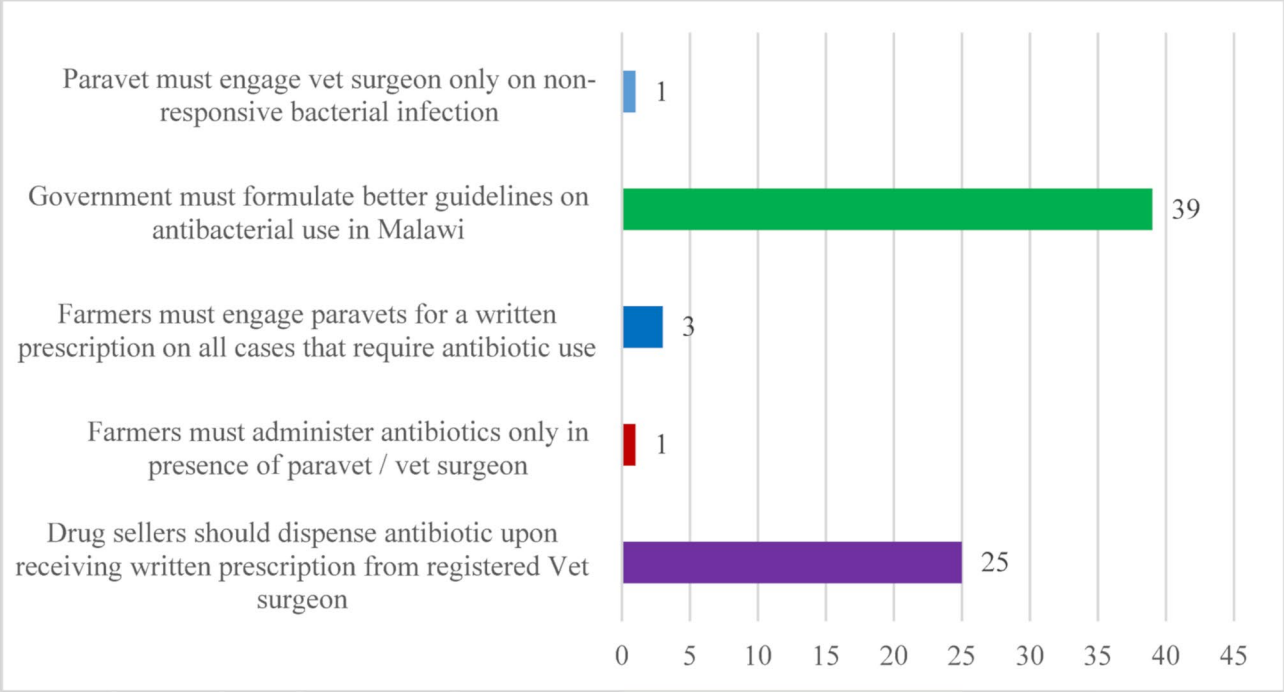

Fig. 5 Frequency of respondents' recommendations regarding antibiotic use

Table 5 Mean knowledge, attitude, and practice scores across socio-demographic characteristics

Variable	Level	Knowledge		Practice		Attitude	
		Mean ± SD	*p*-value	Mean ± SD	*p*-value	Mean ± SD	*p*-value
Sex	Male	11.43 ± 2.49	0.279	8.3 ± 2.3	0.064	8.58 ± 1.47	0.107
	Female	10.77 ± 3.30		7.8 ± 2.1		6.92 ± 1.85	
Age (years)	18–40	11.10 ± 2.97	0.232	12.4 ± 2.9	0.007*	9.23 ± 1.62	0.148
	≥ 40	12.38 ± 0.52		7.7 ± 0.6		8.13 ± 1.73	
Education Level	Diploma in veterinary	10.36 ± 3.31	0.011*	10.0 ± 2.5	0.004*	6.52 ± 1.61	< 0.001*
	Degree in Veterinary	12.67 ± 0.59		9.2 ± 0.9		8.56 ± 0.51	
	MSc/MPH	12.50 ± 0.53		7.6 ± 0.53		8.75 ± 0.46	
	PhD	13.0 ± 0		0.9 ± 0.3		8.0 ± 0	
Specialty	Para-veterinary	10.36 ± 3.31	0.061	10.0 ± 2.5	0.066	6.52 ± 1.61	0.081
	Veterinarian	12.63 ± 0.56		11.7 ± 1.4		8.59 ± 0.50	
Work experience (years)	≤ 5	11.47 ± 3.12	0.124	11.30 ± 3.2	0.147	7.63 ± 1.66	0.172
	≥ 5	11.05 ± 2.57		9.80 ± 3.0		7.08 ± 1.61	
Type of employment status	Private practice	11.47 ± 3.16	0.500	9.0 ± 3.3	0.891	9.50 ± 0	0.204
	NGO employee	12.67 ± 0.58		2.9 ± 0.3		7.27 ± 1.10	
	Government employee	10.98 ± 4.4		8.5 ± 3.4		7.19 ± 1.81	
	Teaching	13.0 ± 0		2.8 ± 0.4		8.33 ± 0.58	
Type of veterinary practice	Large animal practice	9.33 ± 3.28	< 0.001*	6.7 ± 2.4	0.071	6.33 ± 1.58	0.094
	Small animal practice	13.0 ± 0		2.8 ± 0.4		9.50 ± 0	
	Mixed practice	11.38 ± 2.82		10.0 ± 3.3		7.35 ± 1.64	
	Government regulatory/not specific practice	12.67 ± 0.58		2.8 ± 0.4		8.33 ± 0.58	
	Wildlife practice	11.0 ± 0		1.0 ± 0.0		9.0 ± 0	
	Laboratory	12.0 ± 0		0.6 ± 0.5		6.0 ± 0	
Overall		11.25 ± 2.03		8.71 ± 1.34		9.04 ± 1.64	
Range		2–13		5–10			
Maximum obtainable scores		13		11		13	

Std. Deviation = Standard Deviation, *Indicates statistical significant difference at $p < 0.05$

Table 6 Summary of grades for the respondents` KAP levels towards antimicrobial use and resistance

Construct	Level	Proportion ($n=69$)
Knowledge	Good	59 (85.5%)
	Poor	10 (14.5%)
Practice	Good	68 (98.6%)
	Poor	1 (1.4%)
Attitude	Negative	5 (7.2%)
	Positive	64 (92.8%)

n = number of respondents

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12917-025-04837-2.

Supplementary Material 1: S1 Text. English version questionnaire

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Author contributions
Conceptualization: Henson Kainga. Data curation: Henson Kainga, Merning Mwenifumbo and Simegnew Adugna Kallu. Formal analysis: Henson Kainga, Simegnew Adugna Kallu, and Joseph Nkhoma. Investigation: Henson Kainga and Marvin Phonera. Methodology: Henson Kainga, Elisha Chatanga and Marvin Phonera. Supervision: Joseph Nkhoma and Gilson Njunga. Validation: Elisha Chatanga, Joseph Nkhoma and Marvin Phonera. Writing– original draft: Henson Kainga. Writing– review & editing: Merning Mwenifumbo, Simegnew Adugna Kallu, Elisha Chatanga, and Joseph Nkhoma. All authors read and agreed to the contents of the final copy of the manuscript.

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Data availability
The data that support the findings is available under request and condition to maintain confidentiality of the participants.

Declarations

Ethics approval and consent to participate
Ethical clearance approval was granted by Lilongwe University of Agriculture and Natural Resources- Research Ethic Committee (REF NO: LUANAR-REC–REVIEW- 2024-0005) and the study authorization approval was granted by the Animal Health Committee of the Department of Animal Health and Livestock Development Ref: DAHLD/AHC/01/2023/6 and each participant completed a consent form to participate in the study which was included within the introductory part of the questionnaire. The consent form documented the aims, nature, and procedure of the study. The privacy and confidentiality of information was also strictly guaranteed by the principal investigators.

Competing interests
All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Clinical trial number
Not applicable.

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