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Barriers and interventions for appropriate antimicrobial prescribing among veterinarians in Kerala

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Abstract

Antimicrobial resistance (AMR) is a global health emergency. Use of antimicrobials in animals has been implicated in the emergence of AMR in bacterial populations, with undesirable consequences for both human and animal health. The development of AMR is a natural phenomenon. However, due to overuse and misuse of antibiotics in different sectors; human and animal health, aquaculture and agriculture. The rate at which AMR occurring is exponentially increasing. This misuse threatens modern medicine and jeopardizes the safety of the routine treatment of infections. Among the major factors shaping antimicrobial resistance are antimicrobial prescribing and use. Tailoring Antimicrobial Resistance Program is a behavior change methodology that is utilized to adapt behavior change in relation to antimicrobial use. This study explores barriers and interventions for appropriate antibiotic prescription among the Veterinarians working in Animal Husbandry department in Kerala. Data were collected from 336 veterinarians across the Kerala state. Barriers for appropriate antimicrobial prescribing as perceived by the respondents were arrived at through methodology given by Garret and Woodworth (1969). Interventions as perceived by the respondents were arrived by percentage and ranking. Pressure/demand from clients for quick relief, lack of access to antibiotic sensitivity testing laboratory and insufficient fund allotment for drug purchase were the major barriers perceived by the respondents. The major interventions perceived were establishing more antibiotic sensitivity testing laboratory facilities, providing sufficient veterinary manpower in field and strict implementation of legislation to prevent over the counter supply of antibiotics without prescription. The findings would help develop and pilot behavior change interventions among veterinarians with the aim of optimizing appropriate antibiotic prescription and use, which would support the implementation of the antibiotic stewardship program. Effective behavior change interventions should consider multiple factors including individual and organizational factors to optimize appropriate antibiotic prescription.

Keywords: Veterinarians, appropriate antimicrobial prescribing, barriers and interventions

Introduction

Antimicrobial resistance (AMR) is recognised as a complex problem and global threat to human and animal health. Consequently, the World Health Organization (WHO) and its member countries advocate a One Health approach to tackle the crisis of AMR. One Health recognises that the health of humans, animals and the environment is interlinked such that collaborative, multidisciplinary efforts of researchers, policy-makers, practitioners and other stakeholders will be required locally, nationally and globally to achieve an effective response. A cornerstone of the One Health approach to AMR and a key priority of the AMR response strategy is to reduce misuse of antimicrobials and support optimal prescribing practices in human and animal health.

The Ministry of Public Health, Government of India developed the National Action Plan (NAP) to combat Antimicrobial Resistance (AMR) in collaboration with World Health Organization (WHO) and instructed to states to implement the state action plan to reduce AMR occurrences. The Government of Kerala is committed to take appropriate action to address antimicrobial resistance in the state by involving all stakeholders in developing and implementing a state antimicrobial resistance action plan that is aligned with the national and

global antimicrobial resistance action plans for antimicrobial resistance containment with six strategic objectives. Effective implementation of the action plan in the animal husbandry sector is possible only after an analysis of the existing situation and exploring the awareness, views and opinions of veterinarians about antimicrobial use and resistance in animal husbandry sector.

To our knowledge, there are no studies in Kerala explaining AMR behavior drivers among Veterinarians. Under the circumstances discussed above, it was felt that a study that focused on the prescribing behaviour of veterinarians in large animal practice in Kerala was required, as such an investigation could prove vital in understanding the prescribing behaviour of veterinarians, and constraints encountered and preferred interventions. Thus, this study was designed to explore barriers and interventions of appropriate antibiotic prescription from the Veterinarians perspectives in Animal Husbandry Department in Kerala. Accordingly, such a baseline will support stakeholder assessment and review of the suitability of the currently deployed approaches to antibiotic stewardship. The baseline would also provide a strong basis to facilitate in the implementation of complex multidimensional interventions across the healthcare sector. Data of this kind will be extremely useful to the government for making necessary interventions.

Methodology

Barriers to good antimicrobial prescribing behaviour

Barriers for good antimicrobial prescribing behaviour was operationalized as all those factors perceived by the veterinarians that hindered the process of good antimicrobial prescription in their routine clinical practice. Good antimicrobial prescribing behavior is defined as the act of following the stewardship practices such as selecting correct antibiotic, the correct dose, correct frequency and duration and correct route of administration while prescribing an antimicrobial. Possible barriers perceived by the veterinarians were collected through extensive review of literature, themes of the focus group discussion and discussion with subject experts and field practitioners. A total of 18 barriers were collected and grouped as personal barriers, administrative barriers and economic barriers. Ranks for each barrier as perceived by the respondents were arrived at through methodology given by Garret and Woodworth (1969) [8].

Garrett's ranking technique

Garret ranking was used to arrive at the most important factors influencing a respondent. As per this method, respondents were asked to assign a rank to all factors and the outcome of this ranking was converted into a score value with the help of the following formula.

$$\text{Percent position} = 100 (\text{Rij} - 0.5) / \text{Nj}$$

Where,

Rij = Rank given for the ith factor by jth respondents

Nj = Number of factors ranked by jth respondents

With the help of Garrett's table, the percent position estimated was converted into scores. Then for each factor, the scores of each individual were added and then total value of scores and mean values of score were calculated. The mean scores for all the factors were arranged in descending order and thus ranks were assigned to prioritize the factors. The factors having the highest mean value were considered to be the most important factors. Based on the rank the factors perceived to be the most important as well as that perceived to be the least important were arrived at and interpretations were made.

Extension educational interventions to optimize prescribing practices

Extension educational interventions were operationally defined as the extension educational measures perceived by the veterinarians that would optimize the good prescribing behaviour among veterinarians and consequent containment of antimicrobial resistance. A list of 12 interventions that were likely to optimize prescription behaviour was identified from an extensive review of literature, themes of focus group discussions and discussions with subject experts and field veterinarians. These were included in the final questionnaire and the respondents were asked to indicate the extent to which these interventions would optimize appropriate antimicrobial prescription on a three point continuum viz., most important, important and not important. Based on their responses, the most important interventions were identified and interpretations were made.

Results

Barriers in good antimicrobial prescribing behaviour

The results of Table 1 revealed that under personal barrier, the barrier on pressure from clients perceived as being as important by studied veterinarians (67.73) followed by lack of farmer's understanding about antibiotics and resistance (62.96) and difficulty in making an accurate diagnosis (54.2) as major constraints. Barriers of less importance included were fear of missing an infection (48.79), lack of a personal own understanding about antibiotic use and resistance by the veterinarians (36.69) and fear of losing client if veterinarians do not prescribe antimicrobials (32.41).

It was also evident from data in Table 1 revealed that among administrative barriers, the most significant one was the lack of access to antibiotic sensitivity testing laboratories (75.47), the lack of sufficient number of veterinarians in the field (61.46), higher work load and time pressure (60.49), lack of strict legislations to control quacks and over the counter supply of drugs (55.22) and lack of local resistance pattern data (52.25). Barriers of lesser importance as perceived by respondents included lack of rapid diagnostic tests (47.25), lack of clear guidance for antibiotic use (42.06), lack of sufficient trainings on antimicrobial use (37.13) and unavailability of narrow spectrum antibiotics (31.93).

Table 1: Perceived barriers in good antimicrobial prescribing behaviour

Sl. No.	Barriers	Total Garret score	Mean Garret score	Rank
I. Personal barriers				
1	Pressure/demand from clients for quick relief	22759	67.73	1
2	Lack of farmer's understanding about antibiotics and resistance	21154	62.96	2
3	Difficulty in making an accurate diagnosis	18210	54.2	3
4	Fear of missing an infection	16392	48.79	4
5	Lack of my own understanding about antibiotic use and resistance	12420	36.96	5
6	Fear of losing client if I don't prescribe	10890	32.41	6
II. Administrative barriers				
1	Lack of access to antibiotic sensitivity testing laboratory	25357	75.47	1
2	Lack of sufficient number of veterinarians in the field	20651	61.46	2
3	More work load and time pressure	20325	60.49	3
4	Lack of strict legislations to control quacks and over the counter supply of drugs	18555	55.22	4
5	Lack of local resistance pattern data (Antibiogram)	17555	52.25	5
6	Lack of rapid diagnostic tests	15875	47.25	6
7	Lack of clear guidance for antibiotic use	14131	42.06	7
8	Lack of sufficient trainings on antimicrobial use	12475	37.13	8
9	Unavailability of narrow spectrum antibiotics	10727	31.93	9
III. Economic barriers				
1	Insufficient fund allotment for drug purchase	19218	57.2	1
2	Cost of culture and susceptibility tests	17310	51.52	2
3	Cost of antibiotics	14208	42.29	3

Among the economic barriers, insufficient fund allotment for drug purchase (57.2), followed by cost of culture and

susceptibility tests (51.52) and cost of antibiotics (42.29) were perceived to be important by the respondents.

Extension educational interventions to optimise prescribing practices

Table 2: Perceived interventions to optimise prescribing practices

Sl. No.	Interventions	Frequency (f)	Percent (%)
1	Establishing more antibiotic sensitivity testing laboratory facilities	262	84.5
2	Providing sufficient veterinary manpower in field	259	83.5
3	Strict implementation of legislation to prevent over the counter supply of antibiotics without prescription	243	78.4
4	Better public education and awareness about antibiotic resistance through trainings	232	74.8
5	Improving access to rapid diagnostic test	226	72.9
6	More education/training on appropriate antibiotic prescribing practice for veterinarians	219	70.6
7	Implementation of antimicrobial stewardship programmes	216	69.7
8	Making local and national guidelines on antimicrobial use available	204	65.8
9	Making data on local and national antimicrobial resistance patterns available	189	61.0
10	Extension of restriction of critical antimicrobials	169	54.5
11	A system for regular audit and feedback on prescribing	127	41.0
12	Computer- assisted prescribing	124	40.0

The results presented in Table 2 displayed that majority (84.5 percent) of the veterinarians perceived to optimising the establishment of more antibiotic sensitivity testing laboratory facilities, providing sufficient veterinary manpower in field (83.5 percent), strict implementation of legislation to prevent over the counter supply of antibiotics without prescription (78.4 percent), better public education and awareness about antibiotic resistance through trainings (74.8 percent), access to rapid diagnostic test (72.9 percent), more education/training on appropriate antibiotic prescribing practice for veterinarians (70.6 percent) and implementation of antimicrobial stewardship programmes (69.7 percent) as the important interventions to optimise antimicrobial prescribing practices of veterinarians.

The interventions that were received to be of lesser significance included making available local and national guidelines on antimicrobial use (65.8 percent), making available data on local and national resistance (61.0 percent), extension of restriction of critical antimicrobials (54.5 percent), regular audit and feedback on prescribing (41.0 percent) and computer- assisted prescribing (40.0 percent).

Discussion

Barriers to good antimicrobial prescribing behaviour

The findings of the study indicated that pressure or demand from the clients for quick relief was perceived as major barrier under the study heading personal barriers. Similar findings were reported by Sharaf *et al.* (2021) who concluded in a study among physicians and pharmacists in primary healthcare centres in Qatar that the major barrier to appropriate antibiotic prescription was patient pressure. This might be due to the lack of farmer's understanding which was perceived as a second major barrier to good antimicrobial prescribing among veterinarians. Similar findings were reported by Zhuo *et al.* (2018) [22] who conducted a comparative study among doctors, dentists and veterinarians in Australia and reported that the common barriers among all the professions was the lack of client understanding about antibiotics. The study results revealed that third most important perceived barrier was difficulty in making an accurate diagnosis. Difficulty in accurate disease diagnosis due to lack of confidence by veterinarians in this study could be explained by the inadequacies in the post education training of veterinary professionals. Fear of missing an

infection, lack of own understanding about antibiotic use and resistance were the other personal barriers perceived by veterinarians in this study. This findings confirms previous studies that reported a knowledge gap between theoretical concepts and real life situations amongst animal health practitioners (Coyne *et al.*, 2018; Smith *et al.*, 2019) ^[6, 16].

The results revealed that lack of access to antibiotic sensitivity testing laboratories was perceived as a major barrier to good antimicrobial prescribing behaviour among the administrative barriers. Similar findings were reported by Adekanye *et al.* (2020) ^[1] who reported that majority of veterinarians in Nigeria agreed that unavailability of laboratory services was a key barriers to the use of sensitivity test. Accurate diagnosis is necessary to guide the choice of antimicrobial and is fundamental to decision-making in veterinary clinical practice. Veterinary diagnosis involves analysing the case history and clinical examination which should be supported by laboratory tests. Laboratory diagnostic and antimicrobial sensitivity test results are considered an important guide for the selection of antimicrobial by veterinarians (De Briyne *et al.*, 2014) ^[7]. Thus, there is a need for more field diagnostic tools and diagnostics infrastructures to improve veterinary practices and support clinical decisions of veterinarians in Kerala. Development and use of field-friendly disease diagnostics and management tools may improve on antimicrobial use like use of body weight estimation band for different breeds and cross breeds of cattle for accurate dosing of veterinary medicine (Tebug *et al.*, 2018) ^[19]. Strategies that explore ways to increase availability of veterinary laboratory services across the state is of crucial importance in this regard.

However, the other barriers such as lack of sufficient number of veterinarians and increased work load as well as time pressure were also perceived to be major constraints by majority of the respondents. Similar findings were reported by Caudell *et al.* (2020) ^[3] who reported that limited access to animal health professionals observed across different African countries and increased work load as well as restricted time for consultation among physicians respectively. This lack of sufficient number of veterinarians might lead to the emergence of unqualified personnel to fill in the gaps in treatment of animals. Studies have reported that a large number of untrained quack personnel in veterinary practice might be due to the unaffordable nature of professional veterinary services for marginalized farmers in India (Mutua *et al.*, 2020; Sarita *et al.*, 2017; Kumar and Gupta, 2018) ^[12, 14, 10]. Sharma *et al.* (2020) ^[12] also reported in their study that lack of trained veterinarians and inadequate delivery of animal health services appeared to be a major problem in India. Higher workload and time pressure among veterinarians might be due to engagement of veterinarians in implementation of welfare schemes at panchayat level which interfered with the discharge of clinical duties. This points to the need to recruit sufficient number of veterinarians and establishment of separate teams for implementation of schemes which could give veterinarians more time to concentrate on animal treatment appropriately.

In addition, lack of strict legislation to control quack practice and over the counter supply of drugs without a veterinarian prescription was also perceived to be a barrier for good antimicrobial prescribing behaviour by high proportion of veterinarians in this study. Moreover, it is a common practice for animal owners to purchase and administer veterinary medications to animals without the advice of animal health professionals where is a shortage of qualified veterinarians

(Caudell *et al.*, 2020) ^[3]. This practice is favoured by the availability of over the counter medicine to the general public without any prescription from a registered veterinarian (Clement *et al.*, 2019) ^[5]. These findings highlight the need for education of clients, veterinary drug sellers, pharmacists and farmers on appropriate antibiotic use and the risk of antibiotic misuse and antimicrobial resistance. In addition, government intervention on the formulation and implementation of relevant policies and stricter enforcement of appropriate legislation may also be useful in improving appropriate antibiotic use.

The findings also indicated that lack of local resistance pattern data was another barrier to good antimicrobial prescribing by veterinarians. Before making a decision to prescribe, the veterinarian would consider several factors so that their decision is based on sound empirical facts viz., records from previous sensitivity results if available, information on local patterns of bacterial resistance if available and previous patient cultural and sensitivity test results if available. The records from previous antibiotic sensitivity test results and information on local resistant pattern of bacterial resistance are not be available in veterinary institutions of Kerala, emphasizing the need for a state level integrated antimicrobial resistance surveillance programme to generate appropriate local resistance pattern data for important diseases of large animals as recommended by the Kerala Antimicrobial Resistance Strategic Action Plan (GOK, 2018) ^[9].

It was observed from the findings that the barriers of least importance were lack of rapid diagnostic tests, lack of clear guidelines for antibiotic use and lack of sufficient trainings on antimicrobial use.

The findings of the study indicated that the major barrier under the heading economic barriers was insufficient fund allotment for drug purchase followed by cost of culture and susceptibility tests and cost of some antibiotics. In Kerala, most of the drugs needed for veterinary institutions in panchayat level is purchased through fund allotment from the local panchayat administration. The insufficient fund allotment from local administration might be due to the less importance given by local panchayat officials to the animal husbandry sector especially for drugs purchase when compared to welfare schemes. This emphasizes the need for the Department of Animal Husbandry, Kerala to take an active role in the purchase of quality drugs with sufficient fund allotment for all veterinary institutions in the state so as to ensure for appropriate antibiotic prescribing.

Extension educational interventions to optimise prescribing practices

The results of the study revealed that the interventions preferred by majority of the veterinarians were the establishment of more antibiotic sensitivity testing laboratory facilities. Similar findings were reported in human health by Saleem *et al.* (2019) ^[13] who reported in their study that majority of the physicians in Pakistan perceived the need for rapid and effective diagnostic techniques.

Antibiotic sensitivity testing relies on a combination of farmer's awareness as well as willingness and availability of diagnostic tools and facilities. However in India, majority of the farmers depend on livestock and farming for their daily needs. The farmers in Kerala might expect/demand immediate cure for their animals and this explains why majority of the veterinarians in this study perceived a pressure from clients as the major personal barrier for appropriate prescription. This

explains that the farmers are not in a position to spend money to carryout laboratory tests and thereby for the extension of treatment duration. The possible reason for such an attitude among the farmers may be due to lack of awareness and financial difficulties. In this study only 31.25 percent of the veterinarians rarely had conducted trainings directed at making improvements in farmer knowledge on antibiotic use and antimicrobial resistance. It was also disturbing that 21.73 percent of the veterinarians never conducted such trainings for farmers. This highlights the need for creation of awareness through appropriate trainings to change the attitude of farmers. There is also a need for the government to provide at the subsidised rate to farmers. In this study, a good proportion of veterinarians perceived the lack of rapid diagnostic test as a barrier for appropriate prescription and hence, there is an urgent need for the development of specific field diagnostic kits for the detection of disease and development of low cost rapid diagnostic tests which would help in choosing the correct antibiotic, promote their rational use and also prevent resistance.

Moreover majority of the veterinarians in this study perceived the lack of access to antibiotic sensitivity testing laboratory facility as a major barrier among administrative barriers for appropriate prescription. The findings are in accordance with the findings of Vijay *et al.* (2021) ^[20] who reported that majority (70 percent) of the veterinarians in India well equipped antibiotic testing laboratory facilities were lacking. The possible reason for this might be due to the unavailability of laboratory facilities and suitable technical personnel at block level veterinary institutions. Because of this situation, the veterinarians have to send samples to laboratories which are located very far or to private human laboratories which also an additional economic burden to farmers so that they might not show interest in such tests. This highlights the necessity for establishment of antibiotic sensitivity testing laboratory facilities at the block level in Kerala. In addition, the government should make attempts to support farmers by subsidizing the cost for laboratory diagnostics by providing ample funds (World Bank, 2012) ^[21].

In this study the second most preferred intervention by majority of veterinarians was providing sufficient veterinary manpower in field. A study by Chauhan *et al.* (2018) ^[4] reported that due to the acute shortage of professionals, farmers tended to consult either the informal prescribers or the veterinary field assistants. Another study on the preference of service providers for the veterinary service conducted in Maharashtra, India found that farmers would not consult a 'quack' or try to treat the animal on their own if veterinary services were readily available (Mirajkar *et al.*, 2011) ^[11]. Emergence of quacks and untrained personnel might be due to lack of sufficient veterinary services at the needed time for farmers. This highlights the necessity of availability of sufficient number of veterinarians all over the state to man 24 hour services while at the same time ensuring that the rights of veterinarian are protected.

The third important intervention preferred by most of the veterinarians was strict implementation of legislation to prevent over the counter supply of antibiotics without prescription. This might be due to the fact that over the counter sale was one of the perceived barrier to good antimicrobial prescribing by veterinarians in this study. Adekanye *et al.* (2020) ^[1] reported that majority (86 percent) of the veterinarians in Nigeria agreed to countering client-initiated antibiotic therapy without veterinary supervision. The study findings revealed that more than two third of the

veterinarians preferred better public education and awareness about antibiotic resistance through trainings (74.8 percent) and access to rapid diagnostic test (72.9 percent). The findings are in accordance with the findings of Zhuo *et al.* (2018) ^[22] who reported in a comparative study among doctors, dentists and veterinarians in Australia and found that all the three groups of participants perceived better public awareness about antibacterial resistance and access to rapid diagnostic tests as the important measures that would be helpful in supporting more appropriate prescribing in their place of practice.

It was observed from the study findings that quite substantiate proportions of the veterinarians who preferred more education/training on appropriate antibiotic prescribing practice for veterinarians (70.6 percent), implementation of antimicrobial stewardship programmes (69.7 percent), making available local/ national guidelines on antimicrobial use (65.8 percent) and making available data on local and national resistance pattern (61.0 percent). Similar findings were also reported by Zhuo *et al.* (2018) ^[22] and Saleem *et al.* (2019) ^[13]. However, in human sector, Spornovasilis *et al.* (2020) ^[18] who reported much higher proportions of junior doctors in Greece 95.3 percent of doctors indicated that the development and access to guidelines was the most important intervention to optimise appropriate antibiotic prescribing and this was followed by access to local and national antimicrobial resistance data, education on antimicrobial prescribing. This emphasizes the importance given by doctors to human health in developed countries to use the guidelines and local resistance pattern data for appropriate prescribing. The possible reason for lower figures in the present study might be due to lack of trainings, stewardship programmes, lack of profession specific local as well as national guidelines on antimicrobial use and lack of data on local resistance pattern data in Department of Animal Husbandry, Kerala which was observed and discussed in this chapter earlier. This situation could have resulted in not appreciate the importance of stewardship programmes, the use of guidelines for appropriate antibiotic prescribing and the use of local resistance pattern data. This unfelt needs should be changed to felt needs among the veterinarians through appropriate extension educational strategies like more education/training on appropriate antibiotic use, implementing stewardship programmes in animal husbandry sector, generation and making availability of local/national profession specific treatment guidelines in every veterinary institutions and generation as well as making availability of local resistance pattern data in every veterinary institutions in Kerala.

Conclusion

Veterinarians recognize multiple barriers for the appropriate use of antibiotics that include patients' pressure, lack of laboratory facilities and lack of fund for drug purchase. Interventions targeting veterinary healthcare system are needed to overcome the barriers and change behaviors around using antibiotics among veterinarians in Kerala.

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