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Original Research Article

KNOWLEDGE AND AWARENESS OF ANTIMICROBIAL RESISTANCE AND ANTIMICROBIAL PRESCRIBING BEHAVIOUR AMONG YOUNG COMPANION ANIMAL VETERINARY PRACTITIONERS IN SRI LANKA

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SUMMARY: The emergence of antimicrobial resistant (AMR) organisms has become a serious public health threat as it reduces the effectiveness of treatment and increases healthcare costs and mortality. The development of new antimicrobial drugs is extremely slow. The genetic capacity of bacteria to develop resistance is difficult to manipulate. Thus, antimicrobial stewardship among health professionals is encouraged to reduce the rate of developing AMR. This study assesses the awareness and prescription behaviour of companion animal veterinary practitioners in Sri Lanka using a web-based questionnaire. Two outcome variables, awareness of AMR and prescription behaviour were assessed using a scoring system and ranked as appropriate or inappropriate behaviour or high or moderate/low knowledge. Bivariate analysis was performed using the Chi-square test to explore the relationship between two selected outcome variables with the categorical variables (years of experience, gender, geographical area). A total of 102 veterinarians participated in the survey. The respondents included 49 % male and 51% female and were mainly in the age range of 25-35 years (92.4%). Of the listed 18 antimicrobials, doxycycline (93%), metronidazole (92 %), cefuroxime (89%), amoxicillin (87%) and cephalexin (84%) were prescribed often by companion animal practitioners and carbapenems (3%) and aminoglycosides (6%) were rarely prescribed and were complied with the guidelines. Good antimicrobial prescription behaviours such as performing antimicrobial susceptibility testing were often practised only by 1.95% of respondents. Around 23 % of respondents prescribed antimicrobial drugs without confirming an infection as further diagnostics are expensive, and 22 % prescribed antimicrobial drugs as a prophylactic measure and a similar percentage when prescribing immunosuppressive drugs. When the prescription behaviour was evaluated, 41% of the respondents had appropriate prescription behaviour and 59% had inappropriate behaviour. Even though statistically non-significant, the appropriate behaviour was higher among veterinarians with more than two years of experience. When awareness of AMR was assessed, 40% had high awareness and 60% had moderate/low awareness. Conducting awareness programs and developing or adopting appropriate prescription guidelines are essential to improve the prescription behaviour of companion animal veterinary practitioners in Sri Lanka.

KEYWORDS: AMR, prescription behaviour, awareness, companion animal, veterinary

INTRODUCTION

Antimicrobial resistance (AMR) is increasing at an alarming rate around the world. This has significantly increased the mortality rate, hospital stay and healthcare cost of humans and animals (Euro surveillance Editorial Team, 2013; Umber and Bender, 2009). As a result, World Health Organization (WHO) and the World Organization for Animal Health (WOAH, former OIE), have identified antimicrobial resistance as a major public health threat requiring immediate attention (Frost *et al*., 2018). Bacteria develop resistance to antimicrobial drugs due to their inherent resistance mechanisms or through the acquisition of resistance genes and it is usually beyond the control of humans (McManus, 2009). However, a number of other factors including inadequate regulation, lack of awareness, prescription behaviour of health professionals, hygiene, consumption behaviour of patients, overuse and misuse of antimicrobials in

livestock contribute to the dissemination of antimicrobial resistance and resistant organisms (Chukwu *et al*., 2021). Of those, underuse and overuse of antimicrobials are the key factors which facilitate the selection and subsequent spread of resistant organisms. When antimicrobial drugs are used to treat clinical conditions or used as a prophylactic measure, bacteria susceptible to those drugs will be inhibited and resistant organisms will survive. In other words, the use of antimicrobial drugs selectively promotes the growth of resistant organisms.

The number of antimicrobial drugs available to treat various infections is limited. Scientists are continuously working to invent new antimicrobial drugs or to identify mechanisms to control antimicrobial resistance. However, the development of new antimicrobial drugs is a very costly and time-consuming task. Thus, only a very few antimicrobial drugs have been developed in the last two decades (Hutchings *et al*., 2019). Even if antimicrobial drugs are developed, it is certain that microorganisms will soon develop resistance to those drugs as well. Therefore, the focus is now on preventing the development of antimicrobial resistance through antimicrobial stewardship programs (Dyra *et al*., 2017). Antimicrobial stewardship programs focused on optimising the use of antimicrobials, improving patient outcomes, reducing AMR, preventing healthcare associated infections and reducing healthcare costs (Schuts *et al*., 2016).

Treatment failures caused by AMR organisms are not very common in veterinary medicine yet (Lloyd and Page, 2018). However, multidrug resistant (MDR) organisms including methicillin-resistant *Staphylococcus pseudointermedius* (MRSP) and *Escherichia coli* producing extended spectrum beta-lactamase (ESBL) are increasingly reported among dogs and cats (Cocca *et al*., 2021; Marchetti *et al*., 2021) Significant public health concerns are there due to possible risk of animal to human transmission of MDR organisms. In addition, frequent prescription of critically important antimicrobial drugs as the first treatment option by companion animal practitioners has also become a concern (Buckland *et al*., 2016). Antimicrobial stewardship in veterinary medicine can help to preserve the effectiveness of antimicrobial drugs available for human use (Lloyd and Page, 2018). When compared to human health professionals, antimicrobial stewardship among veterinarians is somewhat different. It includes improving awareness of national or international practice guidelines, development of local guidelines on antimicrobial choice and restrictions, improving knowledge of pharmacokinetic and pharmacodynamics aspects of the effectiveness of antimicrobials. In addition, factors affecting the duration of treatment, promoting the use of diagnostic microbiology including susceptibility testing, point of care diagnostics, rapid diagnostic approaches and improve knowledge of critical resistance problems need due attention (Guardabassi and Prescott, 2015). Currently, the awareness of antimicrobial resistance among companion animal veterinary practitioners in Sri Lanka and their prescription behaviour and the factors affecting the prescription behaviour are not known. This survey study was conducted to fill that gap.

MATERIAL AND METHODS

A web-based survey was conducted to collect data on awareness of antimicrobial resistance and antimicrobial prescription behaviours of companion animal veterinary practitioners in Sri Lanka.

Designing of the questionnaire and data collection

A web-based questionnaire (Google form) in English language containing 16 items was designed (supplementary document). The 16 items were categorized under three sections. Section A consisted of five questions and focused on collecting socio-demographic data of participants, section B consisted of seven questions to collect data on antimicrobial prescription behaviour while section C consisted of four questions to assess the awareness of antimicrobial resistance. These three sections contained short answer questions, multiple choice questions as well as 4-point Likert scale questions (1-always; 2-sometimes; 3-rarely; 4-never). The questionnaire was pre-tested and could be completed within 10-15 minutes.

The survey questionnaire was uploaded for online access. The Link to access the questionnaire was posted on the personal Facebook page of the author as well as sent directly to veterinary practitioners via email (n=150) when contact email addresses were available. The veterinarians who are members of the Sri Lanka Veterinary Association (SLVA) were contacted through the association leadership and

requests were sent to participate in the study using the non-personalised web link provided in the email. The link to access the questionnaire was sent to veterinarians practising in all nine provinces of Sri Lanka. The questionnaire was made available to respond between 1st of April 2022 and 1st of May 2022 and data was collected anonymously.

Data analysis

Data were downloaded from Google form to Microsoft Excel worksheet. Responses to questions 1-10 were analysed using the functions available in Microsoft Excel and given as percentages.

Question number 11 was used as the outcome variable to assess the prescription behaviour. Of the 12 conditions listed, five did not require the prescription of antimicrobial drugs and were assigned 1 mark for each of those five questions. The conditions which required the prescription of antimicrobial drugs were assigned a 0 mark. Respondents who score ≥1 were categorized as "inappropriate behaviour and those who scored 0 were categorized as "appropriate behaviour".

A scoring system was used to evaluate the responses for question number 13 and 14 which focused on assessing the knowledge of AMR. A score of one point was given to each of the correct answers and altogether there were 12 answers hence, 12 marks were assigned. Based on the score, knowledge level was categorised as 'high" (scoring ≥ 8 points) and "moderate or low" (< 8 points).

Bivariate analysis was performed using the Chi-square test or Fisher's exact test (when it was not appropriate to perform the Chi-square test) to explore the relationship between two selected outcome variables of each category (prescription behaviour and awareness) and selected variables (gender, years of experience: >2Y or <2Y, urban or rural, following a guideline or not). A P-value of ≤0.05 was considered statistically significant.

RESULTS

Out of the 150 small animal veterinarians to whom the Google form was sent as mentioned above, 102 had accessed it and completed the survey. The rate of completion of the questionnaire was 68%. The respondents included 49 % (n=50) male and 51 % (n=52) female and were predominantly within the age range of 25-35 years (92.4%). Most of the respondents were from the Western Province (33.3 %) followed by Central (16.2%) and Southern provinces (13.3 %).

According to the responses to question number 6, only 7.5 % of veterinarians used to obtain the results of antimicrobial susceptibility testing before prescribing antimicrobial drugs and a vast majority of veterinarians (90%) prescribed antibiotics to dogs and cats when there are clinical signs suggestive of bacterial infection. The remaining respondents (2.5 %) indicated that antimicrobial drugs are prescribed to each and every case presented to them.

It was revealed that 18 antimicrobials namely, doxycycline, ampicillin, amoxicillin, gentamicin, trimethoprim sulphonamides, cefuroxime, cephalexin, ceftriaxone, clavulanated-amoxicillin, clindamycin, metronidazole, erythromycin, chloramphenicol, ceftazidime, cefoxitin imipenem, meropenem and amikacin which are restricted for human medication are the ones which are prescribed frequently. As far as the behaviour of prescribing antimicrobials is concerned, doxycycline, metronidazole, cefuroxime, amoxicillin, cephalexin, trimethoprim sulphamethxazole and clavulanated-amoxicillin were prescribed often or very often to cats and dogs. On the contrary, imipenem (1%), meropenem (3 %) amikacin (3%), chloramphenicol (3 %), gentamicin (6%) and ceftazidime (8 %) were very rarely prescribed by companion animal practitioners participated in the survey as shown in Figure 1.

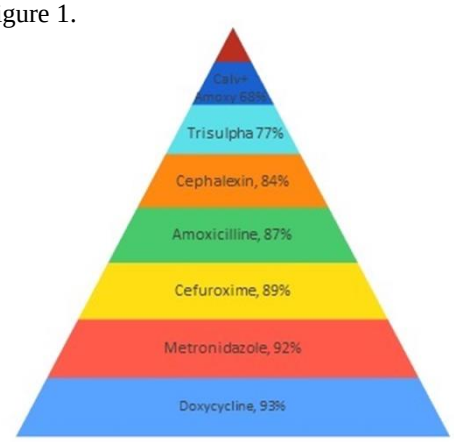

Figure 1: Most commonly prescribed antimicrobial drugs for cats and dogs in Sri Lanka

For question number 8 which was aimed to find out the frequency of following good antimicrobial prescription behaviour such as performing antimicrobial susceptibility testing (AST), only

1.9% of respondents were found to be performing AST frequently while 61.9 % of respondents were not in the habit of performing AST or rarely performing it when prescribing antimicrobial drugs. The responses for question number 9 which meant to gather information on the frequency of detecting multidrug resistant infection were not analysed as the companion animal practitioners requested order culture and AST very rarely (according to the answer given to a previous question).

Sometimes antimicrobials have been prescribed to cats and dogs without confirming an infection. Question number 10 focused on understanding the reasons for prescribing antimicrobials without confirming the presence of infection, around 23 % of respondents indicated it was because further diagnostics are expensive. Around 22 % of respondents had indicated that they prescribed antimicrobial drugs as a prophylactic measure and a similar percentage had indicated that antimicrobial drugs are prescribed when prescribing immunosuppressive drugs. Of the remaining respondents around 20% had indicated that they prescribed antimicrobials when the cause of the disease was difficult to identify. Only 6% had indicated that the antibiotics are not prescribed to patients with no confirmed infection.

The question numbers 10 and 11 which were designed to to evaluate the prescription behaviour of participants, it was evident that 41% of the respondents had appropriate prescription behaviour and 59% had inappropriate prescription behaviour. The Chi-square test performed to see whether those behaviours had any association with the gender and years of experience of the veterinarian, and geographical location (urban or rural) of the practice revealed that the percentage of appropriate behaviour among companion animal veterinarians who were having more than two-year experience than the veterinarians with less than two-year experience (Table 1). However, that difference was not statistically significant (p value = 0.1278). There was no significant difference in the prescription behaviour among males and females; and veterinarians practising in different geographical locations (urban or rural).

For question numbers 13 – 16 designed to assess the awareness of antimicrobial resistance among small animal veterinary practitioners and to understand their source of information, most small animal veterinary practitioners responded (94.3%) indicating that their prescription behaviour can contribute to increasing antimicrobial resistance. According to the scores obtained for questions 13 and 14, 40% of the respondents had high awareness of AMR while reaming respondents (60%) had moderate to low awareness. There was no significant association of awareness with gender, geographical location or years of experience (Table 1). According to the responses to question 15, the majority of the respondents were not aware of the antimicrobial prescription guidelines and only 18% were following the guidelines practised in other countries. For the question number 16 which was to meant to identify the sources that companion animal veterinary practitioners used to update their knowledge on antimicrobial resistance and appropriate antibiotic treatment, 83.8% of veterinary practitioners responded indicating that they use the information available on the internet along with textbooks (60.7%), scientific journals (63%), communicating with experts (23%) and colleagues (58 %), and participation in continuing education programmes (48%) to update their knowledge.

Table 1: Differences in antimicrobial prescription behaviour and awareness according to the years of experience, gender and geographical location of the practice

Variables	Behaviour			Awareness		
	Appropriate	Inappropriate	*P* value	High	Medium/Low	*P* value
Years of experience						
> 2 years (n=68)	33	35	0.1278	28	40	1
< 2 years (n=34)	10	24		13	21	
Gender						
Male (n=50)	23	27	0.5685	20	30	0.5711
Female (n=52)	20	32		26	26	
Location						
Urban (n=63)	29	34	0.6978	26	37	0.9415
Rural (n=39)	15	24		15	24	

DISCUSSION

In the present study, antimicrobial prescription behaviour and awareness of antimicrobial resistance among companion animal veterinary practitioners were assessed using an online survey. It is important to understand the current knowledge of this topic among veterinary practitioners in order to plan and conduct a program to improve the knowledge and awareness on AMR, In other countries, a number of studies have been conducted to assess the knowledge and awareness of AMR among companion animal practitioners (Galarce *et al*., 2021; Jessen *et al*., 2017; Buckland *et al*., 2016). In Sri Lanka, such studies have been conducted among medical professionals (Shu *et al*., 2022; Jayaweerasingham *et al*., 2019) but are limited among veterinary practitioners (Gunasekara *et al*., 2022).

In order to prevent the overprescription of antimicrobial drugs, it is recommended to confirm the presence of active infection using bacterial culture and isolation. A similar survey done in other countries has indicated that culture and isolation had always been used before prescribing antimicrobial drugs (Chukwu *et al*., 2021). According to the results of our study, only 1.9 % have indicated that they used bacterial culture isolation and AST very often. Reasons for prescribing antimicrobial drugs without confirming infections were attributed to the high cost associated with culture isolation and AST and difficulty in identifying the exact cause of the disease due to lack of diagnostic facilities. Therefore, it would be important to encourage the establishment of privately owned veterinary diagnostic facilities and establish diagnostic laboratories at government veterinary hospitals. One of the main reasons for overprescribing antimicrobial drug is the belief of veterinarians that antimicrobial drugs should be prescribed when giving immunosuppressive drugs or when treating cancer patients. In addition, a considerable proportion of respondents believe that the antimicrobial drug should be prescribed to patients with fever. It is important to note that fever is only a sign of inflammation and could occur due to many reasons including viral infections, autoimmune diseases, malignancies or due to thromboembolic diseases (Limper *et al.*, 2010). It should be emphasised that prescribing antimicrobials should be avoided if active infection is not confirmed by cytological examination, rapid diagnostic testing or standard microbiological procedures.

There is a concern about prescribing companion animals certain antimicrobials that are considered second or third-line therapeutic for humans (Mateus *et al*., 2011). According to standard guidelines, narrow-spectrum antimicrobials are recommended as first-line treatment for bacterial infections.

Results showed that the small animal veterinarians in Sri Lanka frequently prescribed doxycycline, metronidazole, cefuroxime, cephalexin and amoxicillin. Frequent use of doxycycline is acceptable as it is a first-line treatment for various infections such as Ehrlichiosis, respiratory tract infections and skin infections (Chukwu *et al*., 2021). Also, the use of amoxicillin, cephalexin and cefuroxime as first-line treatment is acceptable. However, there is no data available on the local resistance frequencies of different organisms for these commonly prescribed antimicrobials. According to guidelines published by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases, if local resistant rates exceed over 20%, it is not recommended to prescribe that antimicrobial drug empirically (Gupta *et al*., 2011). Furthermore, the use of ampicillin or amoxicillin alone for empiric treatment is no longer recommended due to the relatively high rate of resistance observed for those drugs worldwide. The high prescription rate of metronidazole among companion animal practitioners in Sri Lanka could be due to its common prescription to prevent bacterial translocation and septicaemia following haemorrhagic gastroenteritis caused by parvovirus in dogs. In addition, metronidazole is a comparatively cheap intravenous preparation available locally and used to treat sepsis and anaerobic infections. As it is also considered an important antimicrobial drug for both human and veterinary patients, it would be good to limit the use of metronidazole in companion animals. Carbapenems (imipenem and meropenem) are critically important antimicrobial drugs used to treat infections caused by ESBL producing organisms (Tilahun *et al*., 2021). Contrary to findings of developed countries (Mateus *et al*., 2011; Van Cleven *et al*., 2018) Companion animal veterinary practitioners in Sri Lanka very rarely prescribe those drugs and it is a good prescription behaviour.

We listed 12 clinical conditions, of which five do not need antimicrobial therapy (i.e. non-productive cough, fever, cancer, mild diarrhoea, when prescribing immune suppressive drugs) and seven conditions which require antimicrobial therapy, to assess whether the companion animal veterinary practitioners prescribe antimicrobial drugs only when necessary and avoid unnecessary prescription. Accordingly, prescription behaviour was ranked as appropriate (41%) and inappropriate (59%). A similar study conducted in Belgium has reported only 48.3 % of small animal veterinarians had appropriate prescription behaviour complying with the prescription guidelines (Van Cleven *et al*., 2018). A recent study conducted among companion animal veterinary practitioners in the UK has identified several factors that lead to inappropriate prescription and those include satisfying clients to operate the business successfully, cost and time involved in diagnostic procedures, fear of misdiagnosing an infection, habitual practice and pharmaceutical factors (King *et al*., 2018). Our results are also in agreement with those findings and the majority of veterinarians have indicated that antimicrobial drugs are prescribed as it is difficult to arrive at a definitive diagnosis as further diagnostic tests are expensive.

As the percentage of inappropriate prescription behaviour was high, it is important to conduct awareness programs to improve the knowledge of companion animal practitioners in Sri Lanka on AMR. In addition, introducing suitable guidelines developed by other countries or developing a guideline for Sri Lanka is important to improve prescription behaviour. The need for guidelines for companion animal veterinary practitioners has been identified by a number of veterinary organisations including the British Small Animal Veterinary Association (BSAVA) and the Federation of European Companion Animal Veterinary Associations (FECAVA). A study conducted by Weese *et al*., (2006) has shown that the guidelines on antimicrobial use can improve the prescribing behaviour of companion animal veterinary practitioners.

When awareness of AMR was assessed using the scores that the participants obtained for 12 questions, it was evident that 40.1 % had high awareness and 59.9 % had moderate to low awareness. As the percentage with moderate to low awareness was high, it is important to educate veterinarians on AMR. Most of the participants have indicated that they update their knowledge on AMR through websites. In other countries, the percentage of veterinarians reading journal articles seems to be high. To promote reading journal articles, it would be a good idea to upload the web links of relevant open access articles on to a website or Facebook pages of professional associations.

CONCLUSION

According to the survey results, it is justifiable to mention that the awareness of antimicrobial resistance among young companion animal practitioners is satisfactory. Nevertheless, it is necessary to conduct programs to improve awareness further. As only 41% of companion animal veterinary practitioners had acceptable prescription behaviour, improving the prescription behaviour and developing suitable guidelines on antimicrobial prescription for companion animal veterinarians in Sri Lanka is necessary.

LIMITATIONS OF THE STUDY

It was impossible to calculate an accurate sample size due to the lack of information on the number of companion animal veterinary practitioners in Sri Lanka. It would be good to have a registry of all companion animal practitioners in the country as it would be helpful in many aspects.

The lack of responses from experienced senior companion animal practitioners is a limitation of this study. This may be due to the method of conducting the survey. The survey was conducted online using email and social media which are not familiar to the majority of senior veterinarians. Most of the young veterinarians frequently used social media and electronic communications hence, mostly the younger veterinarians participated in the study. It will be good to conduct this type of survey both electronically and using a conventional method i.e. a printed questionnaire to increase the responses from senior veterinarians.

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