A scale to measure the perception of veterinarians towards antimicrobial use and resistance[#]

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Abstract

Veterinarians are the primary sourceof knowledge for farmers on how to use antibiotics responsibly in farm animals and how to decrease the risk of antibiotic resistance.Antimicrobial use and resistance is a multidimensional construct that lacks a specific measurement scale. This paper looks into the development of a scale to assess veterinarian perception about antimicrobial use and resistance. Following a thorough literature review, focus group interviews were conducted with selected key informant veterinarians to identify statements.An initial list of 80 statements reflecting positive and negative perception towards antimicrobial use and resistance was prepared. After editing, a final list of 70 statements were arrivedat. Descriptives of antimicrobial use and resistance, consensus regarding antimicrobial use and resistance indicators were arrived at through relevancy rating by a panel of 40 judges in the field of veterinary science based on which 35 statements were selected for item analysis. These 35 statements were subjected to item analysis among 60 veterinarians selected from a non-sample area. Out of the 60 veterinarians to whom the items were administered for item analysis, 15 veterinarians each with the lowest and highest scores were used as the two criterion groups to evaluate individual items.

Individual items were selected based on't' value whereinitems that had a t-value of more than 1.75 were selected and incorporated into the final schedule. Based on the calculated't' values, 14 items were finally selected and includedin the final scale. Reliabilityof the scale was tested using Cronbach's alpha coefficient of reliability test for which a Cronbachalpha of 0.852 was obtained indicating the internal consistancy of the scale.

Key words:*Veterinarianperception, antimicrobial use and resistance, scale, reliability*

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Introduction

Antibiotic overuse and misuse in livestock have the potential to affect the emergence of antibiotic-resistant organisms in animals(Prestinaci *et al.,* 2015). The emergence of antibiotic-resistant bacteria can increase the severity of infection and death of animalsthusrestricting veterinarian treatment choices(Lhermie *et al.,* 2017). Resistant organisms that spread in the environment have been recognized as posing seriousrisks to human health (Manaia, 2017), while antibiotic residues are important in promoting the emergence of antibiotic resistant bacteria in the environment through selective pressure (Ben *et al.,* 2019). It is therefore important that appropriate antibiotic use protocols are rigorously followed by veterinarians in order to prevent the development of antibiotic resistant bacteria in farm animals and thus protect animals, humans, and the environment in the context of One Health (Robinson *et al.,* 2016).

Veterinarians have a crucial role in promoting measures to reduce the risk of antibiotic resistance on account of the use of these drugs in farm animals, as well as educating their various stakeholders on judicious use of antibiotics. In fact, the success of antibiotic resistance reduction programs is closely related to changes in attitudes held by veterinarians and their clients about the prescription and administration of antibiotics (Oliver *et al.,* 2011). For this reason, it is important to understand how veterinarians perceive the concept of antibiotic use and resistanceassuch an understanding is critical to identifyareas for action in veterinaryeducation and training programmes to improve antibiotic prescribing and use. In this direction, this paper discusses the developing a scale to measure the perception of veterinarians in large animal practice towards antimicrobial use and resistance.

Materials and methods

The method of the summated rating was used to develop a scale on perception of veterinarians about antimicrobial use and resistance as per the procedure of Likert(1932). A total of 80 statements reflecting the perception of veterinarians about antimicrobial use and resistance were prepared through a review of literature, using the themes that emerged from the focus group discussions with veterinarians and one to one discussion with subject matter specialists. Due care was taken to cover all the relevant aspects of antimicrobial use and resistance. Items were designed so as to include positive and negative statements to reduce the effects of social desirability and positive response bias, as well as to maintain the respondent's consistency in responding to the assertions (Lal, 2014).

The statements were edited as per the 14 informal criteria prescribed by Edwards (1969). Out of the 80 statements, 10 statementsthat were found to be factual were rejected and the 70 statementsremaining that were non-ambiguous and non–factual were thus retained after editing.

Relevancy analysis

Relevancy of the statements was ascertained through extensive scrutiny by an expert panel of 150 judges.For this, the edited list of 70 statements was sent through email as a Google form link to the panel of judges who were experts in the various fields of veterinary sciences.The judges were requested to critically evaluate each statement for its relevancy to assess the perception of veterinarians about antimicrobial use and resistance.The judges were requested to give their response on a four point continuum *viz.,* very relevant, relevant, somewhat relevant and not relevant with scores of 4, 3, 2 and 1 respectively.Within a time span of one month, 40 judges returned their responses which were used for the relevancy analysis. The relevancy score of each statement was arrived at by adding the scores that each judge had assigned to a statementon the rating scale. From this data, three criteria *viz.,* relevancy percentage, relevancy weightage and mean relevancy scores were worked out for all the statements and statements with a relevancy percentage more than 75, a mean relevancy weightage of more than 0.80and a mean relevancy score more than 3.2 were selected (Harisha *et al.,* 2020).Thus through the process of relevancy analysis, a total of 35 statements which got the above mentioned criteria were selected.

Item analysis

Item analysis was then done for the 35 statements that emerged after relevancy analysis. The objective of item analysis was to arrive at items that would differentiate respondents with high perception scores from those with lower perception scores on the subject of research, antimicrobial use and resistance.

The 35 statements that were judged relevant werethen sent to a list of non-sample 100 veterinarians in four districts of Kerala *viz.,* Palakkad (25), Malappuram (25), Thrissur (25) and Kasaragode (25) with a request to indicate their degree of agreement or disagreement with each statement on a five-point continuum, strongly agree, agree, undecided, disagree and strongly disagree. The scoring pattern adopted was from five to one, for responses of strongly agree, agree, undecided, disagree and strongly disagree for positive statements. In the case of negative statements, the scoring pattern was reversed. Out of the 100 veterinarians, a total of 60 veterinarians responded within a time span of one month and their responses were taken into consideration for the item analysis procedure. The total score of each respondent was calculated by summing up the scores assigned to each statement.

The total scores of all the 60 veterinarians were then arranged in descending order. The higher 25 per cent of these scores were considered as the high group and the lowest 25 per cent of scores so arranged formed the low group. These two groups served as criterion groups for evaluating individual statements as suggested by Edwards and Kilpatrick (1948). Out of the 60 veterinarians who had responded for item analysis, 15 veterinarians with the lowest scores and 15 with the highest scores were used as criterion groups to evaluate individual items. The critical ratio *i.e.,* the't' value, which is a measure of the extent to which a given statement differentiated between the high and low groups of respondents for each statement was calculated using the formula suggested by Edwards and Kilpatrick (1948) as follows:

$$t = \frac{X_H - X_L}{\sqrt{\dfrac{SH^2}{nH} + \dfrac{SL^2}{nL}}}$$

Where,

X_H= the mean score on the given statement for the high group

X_L= the mean score on the given statement for the low group

SH^2= the variance of the distribution of responses of the high group to the statement

SL^2= the variance of the distribution of responses of the low group to the statement

nH= the number of subjects in the high group

nL= the number of subjects in the low group

Selection of statements for final scale

Items for the final scale were selected based on the't' value. The "t" value indicated the extent to which a statement could differentiate between individuals with high and low perceptions towardsantimicrobial use and resistance. After computing the "t" value for all the 35 statements, 14 statements with the highest "t" value equal to or greater than 1.75 (Edwards, 1969) were finally selected and included in the scale to assess perception of veterinarians about antimicrobial use and resistance.

Fourteen statementswith t values of 1.75 and higher were incorporated in the final scale for assessing the perception of veterinarians about antimicrobial use and resistance. The t-values were significant at a 5 per cent level of significance. Both positive and negative statements, (seven each) were incorporated and found a place in the final scale(Table 2).

Content validity

This is a validity by assumption (Guilford, 1954). The content validity of the scale was established by identifying items for inclusion in the scale based on review of literature and themes of the focus group discussions and through seeking the opinion of panel of the judges.

Reliability of the scale

The reliability of the test was determined by the Cronbach's alpha coefficient of reliability test. The test was administered to 40 non sample veterinarians who were selected randomly from Kannur and Kozhikode districts of Kerala. They were asked to give their responses to the 14 scale statements, that were finally arrived at, on a five point continnum ranging from strongly agree to strongly disagree. The datacollected were then tabulated and analysed to estimate the alpha value using the following formula.

$$\alpha = \frac{K}{K-1}\left(\frac{\sum_{i=1}^{K}\sigma^2 y_i}{\sigma^2 x}\right)$$

Where,

α = Cronbach's alpha reliability coefficient.

K = Number of items.

$\sigma^2 y_i$ = the variance of item i for the current sample of persons.

$\sigma^2 x$ = the variance of the observed total test scores.

In the present study, SPSS version 26 was used to calculate the alpha value.

Reliability Statistics	
Cronbach's Alpha	No. of Items
0.852	14

The Cronbach's alpha was found to be 0.852, which indicated strong internal consistency among the 14 items. Essentially, this meant that respondents who selected high scores for one item also selected high scores for the others and vice-versa. Thus, knowing the score for one statement would enable one to predict with some accuracy the possible scores for the other statements.

In Table 3, the column containing the 'Corrected Item-Total Correlation' indicated the correlation between a given item and the summated score of all other remaining items. In Table 3, correlation between item 1 and the summated score of items 2 to 14 was r = 0.488. This indicated that, there was average and positive correlation between the scores on the one item (Item1) and the combined score of the remaining items (item 2 to item 14). The rule-of-thumb is that these values should be at least 0.40 (Gliem and Gliem, 2003).

In Table 3, the column containing the "Cronbach's alpha if item deleted" indicated the Cronbach's alpha reliability coefficient for the internal consistency score that would result if the individual item was removed from the scale. For example, In Table 3, the Cronbach's alpha of the scale would drop from the overall total of 0.852 to 0.8313, if item 2 were removed from the scale. It explains that the alpha would drop with the removal of second statement, which thus appears to be useful as it contributes to the overall reliability of the scale.

Cronbach's alpha reliability coefficient normally ranges between 0 and 1.The value of alpha is determined both by the number of items in the scale and the mean inter-item correlations. George and Mallery (2003) provided the following rule of thumb for the value of Cronbach's alpha (α)> 0.90 – excellent, α> 0.80 – good, α> 0.7 – acceptable, α> 0.6 – questionable, α> 0.5 – poor and α< 0.5 – unacceptable. In the present scale that was developed, the alpha value found to be good, indicating a strong internal consistency among the set of items, and that the items used in the scale were appropriate and reliable.

Results and discussion

Measurement is a basic necessity of science since it provides researchers with opportunities to enhance their knowledge about various phenomena. The importance of measuring constructs is especially so in the social sciences where many at times these constructs do not lend themselves to direct measurement. Scales are very important tools that can be used to assess such latent constructs. In the social sciences, scales have been widely used to measure behaviours and attitudes. Scales also find application in hypothetical situations that we propose in our attempt to gain a theoretical appreciation of concepts in the world that cannot be assessed directly. The present research paper describes in detail the procedure followed to develop a scale

Table 1 't' values of statements

S.No.	Statements	't' value
1	Limited use of antimicrobials will stand in the way of good animal care.	0.203
2	I feel that antimicrobials are overused worldwide.	-7.273
3	At the first instance, I avoid the use of antibiotics in treatment of animals.	2.438*
4	I feel my colleagues overprescribe antimicrobials.	-5.793
5	Antimicrobials should be used only when prescribed by veterinarians.	-0.595
6	Many a time, I too overprescribe antimicrobials during my clinical practice.	2.449*
7	It would be a very good practice to comply with antimicrobial prescription policies.	-1.254
8	Antimicrobials are overused in the veterinary profession when compared to other sectors.	-5.578
9	Interactions with pharmaceutical representatives and marketing officers influence my antimicrobial prescription.	-1.898
10	Broad spectrum antibiotics are a better choice for most bacterial infections.	2.931*
11	Antimicrobials are often prescribed because it takes time to identify the causative organism responsible for the infection.	-0.904
12	I am confident that I use antimicrobials optimally in my treatment.	0.000
13	High cost of antimicrobials reduces their use in veterinary practice.	1.047
14	I would like more training on the appropriate use of antimicrobials.	0.336
15	In cases where the causative organism is not identified, the veterinarian will resort to antimicrobials.	-4.883
16	New generation antimicrobials should be used only when absolutely necessary.	-1.183
17	Broad spectrum antimicrobials are ideal to use as first line antimicrobial choice.	-3.885
18	Training programmes on the use of antimicrobials must be organized for veterinarians to reduce use of these drugs.	1.900*
19	One need not to wait for culture andsensitivity tests before treating a case with antimicrobials.	3.962*
20	The veterinarian must try other methods of treatment before prescribing antimicrobials.	4.026*
21	Veterinarians often have to prescribe antimicrobials due to pressure of farmer expectations for quick relief.	-4.025
22	A higher frequency of use of antibiotics will decrease the efficacy of drug.	3.697*
23	Having a policy on antimicrobial prescription would benefit veterinary practices.	-1.214
24	I think twice before I prescribe antimicrobials.	-1.468
25	The past experience of a veterinarian is more important in antimicrobial prescription than going in for lab tests.	1.974*
26	Antimicrobial resistance is an increasingly important global threat to human and animal health.	-2.153
27	In recent years, I have become more aware of the impacts of antimicrobial resistance.	4.036*
28	I think that the longer the duration of antimicrobial use, the better is the response.	2.472*
29	I am more concerned about antibiotic resistance in society when I prescribe antibiotics.	2.714*
30	I prefer to resort to culture and sensitivity tests only after getting a poor response to an initial antibiotic therapy.	1.932*
31	In recent times, there has been an increase in the number of incidences of antimicrobial resistance at my facility or practice.	0.367
32	Antibiotics can be routinely used in large animal practice as they are safe drugs.	1.852*
33	One should have sufficient knowledge about antimicrobial resistance to prevent this problem.	-2.153
34	The price of antibiotics must be decreased to encourage their use	-7.155
35	It is necessary to create more awareness of antimicrobial resistance.	2.381*

*Selected statements

Table 2. Final scale on perception of veterinarians about antimicrobial use and resistance

S.No.	Statements
1.	At the first instance, I avoid the use of antibiotics in treatment of animals.
2.	Many a time, I too overprescribe antimicrobials during my clinical practice. *
3.	Training programmes on the use of antimicrobials must be organized for vets to reduce their use.
4.	Broad spectrum antibiotics are a better choice for most bacterial infections. *
5.	The veterinarians must try other methods of treatment before prescribing antimicrobials.
6.	One need not wait for culture and sensitivity tests before treating a case with antimicrobials. *
7.	A higher frequency of use of antibiotics will decrease the efficacy of a drug.
8.	The past experience of a veterinarian is more important in antimicrobial prescription when compared to lab tests. *
9.	In recent years, I have become more aware of the impacts of antimicrobial resistance.
10.	I think that the longer the duration of antimicrobial use, the better will be the response. *
11.	I am more concerned about antibiotic resistance in society when I prescribe antibiotics.
12.	I prefer to resort to culture and sensitivity tests only after getting a poor response to an initial antibiotic therapy. *
13.	It is necessary to create more awareness about antimicrobial resistance.
14.	Antibiotics can be routinely used in large animal practice as they are safe drugs. *

* Negative statements

Table 3. Cronbach's alpha test results for internal consistency of scale

Items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Item 1	35.85	53.36	0.488	0.848
Item 2	34.90	51.16	0.694	0.831
Item 3	34.95	51.89	0.581	0.837
Item 4	36.15	51.20	0.615	0.834
Item 5	36.10	50.96	0.586	0.836
Item 6	35.12	50.00	0.663	0.831
Item 7	34.87	50.72	0.679	0.831
Item 8	35.77	56.23	0.444	0.825
Item 9	36.27	54.30	0.503	0.842
Item 10	36.30	53.13	0.413	0.847
Item 11	36.45	53.63	0.439	0.842
Item 12	35.90	53.01	0.557	0.839
Item 13	35.77	52.99	0.447	0.844
Item 14	35.10	53.57	0.455	0.821

to assess the perception of a key player- the veterinarian- in an important emerging situation in today's world, antimicrobial resistance. The scale so developed, could be of valuable use to various agencies and practitioners interested in measures to mitigate antimicrobial resistance in various parts of the world. The advancement of science would inevitably result in the emergence of novel research situations that require appropriate modes of assessment. The scale that has been developed in this paper assumes significance in the aforementioned context. A similar scale to assess perception was constructed by Kumar *et al,* (2021) who developed a scale to assess the perception of farmers towards dairy-based farmer producer companies.

The final scale developed in this paper thus consisted of 14 statements (7 positive and 7 negative).For practical use this scale should be administered to veterinarians to assess their perception about antimicrobial use and resistance. Responses to each statement can be obtained on a five point continuum *viz.,* strongly agree, agree, undecided, disagree and strongly disagree with weightages of 5,4,3,2 and 1 respectively for positive statements and reverse scoring for negative statements. The perception score of each respondent can be calculated by summing up the scores obtained for all the statements. The perception score for an individual would range from a minimum of 14 to a maximum of 70. Based on the total scores obtained, the respondents can be categorized into those having high, medium and low perception. A higher score would indicate that the respondent had a better perception about antimicrobial use and resistance and vice-versa.

Conclusion

The present study explores the development of a psychometric tool to assess the perception of veterinarians about antimicrobial use and resistance. In this study, the universe of statements were derived from codes and themes obtained from thematic analysis of focus group discussionsand the validity of the statements was ensured through the judges rating while reliability and internal consistancy was ensured with Cronbhac alpha.The reliability and validity of the scale indicated the precision and consistency of the results.

Conflict of interest

The authors declare that they have no conflict of interest.

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