www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2022; SP-11(7): 3690-3694

www.thepharmajournal.com
Received: 14-05-2022
Accepted: 17-06-2022

**G Vijayakumar**
Ph.D., Research Scholar, Department of Veterinary and Animal Husbandry Extension, College of Veterinary and Animal Sciences (CVAS), Kerala Veterinary and Animal Sciences University (KVASU), Kerala, India

**P Reeja George**
Professor, Department of Veterinary and Animal Husbandry Extension, College of Veterinary and Animal Sciences (CVAS), Kerala Veterinary and Animal Sciences University (KVASU), Kerala, India

**RS Jiji**
Professor and Head, Department of Veterinary and Animal Husbandry Extension, College of Veterinary and Animal Sciences (CVAS), Kerala Veterinary and Animal Sciences University (KVASU), Kerala, India

**R Senthilkumar**
Professor, Department of Veterinary and Animal Husbandry Extension, College of Veterinary and Animal Sciences (CVAS), Kerala Veterinary and Animal Sciences University (KVASU), Kerala, India

**M Mini**
Professor and Head, Department of Veterinary Microbiology, College of Veterinary and Animal Sciences (CVAS), Kerala Veterinary and Animal Sciences University (KVASU), Kerala, India

**VL Gleeja**
Assistant Professor, Department of Statistics, College of Veterinary and Animal Sciences (CVAS), Kerala Veterinary and Animal Sciences University (KVASU), Kerala, India

**Corresponding Author**
**G Vijayakumar**
Ph.D., Research Scholar, Department of Veterinary and Animal Husbandry Extension, College of Veterinary and Animal Sciences (CVAS), Kerala Veterinary and Animal Sciences University (KVASU), Kerala, India

# A test to measure the knowledge of veterinarians about antimicrobial resistance and stewardship

**G Vijayakumar, P Reeja George, RS Jiji, R Senthilkumar, M Mini and VL Gleeja**

**Abstract**
Veterinarians are playing a crucial role in disseminating knowledge to the farmers regarding appropriate antimicrobial use, effects of inappropriate antimicrobial use and development of antimicrobial resistance. The veterinarian requires in-depth understanding about antimicrobial resistance and stewardship practices while making the prescribing decision and this knowledge is the basis for right choice of antimicrobials. Due to the dearth of a suitable test for measuring the knowledge of veterinarians about antimicrobial resistance and stewardship, it was necessary to construct a test for the purpose. Therefore, an attempt has made to develop a test for measuring the knowledge of veterinarians about antimicrobial resistance and stewardship. Pertinent 52 items were collected covering all aspects of antimicrobial resistance and antimicrobial stewardship. After getting the jury opinion on the items, forty five items were selected and administered to 100 veterinarians in non-sample area for item analysis. Finally, those items that had a difficulty index ranging from 0.25 to 0.75, discrimination index above 0.45 and point bi-serial correlation value that was significant at 5 per cent level of significance were selected for the final knowledge test. Thus 20 knowledge items were included in the final format of the knowledge test. The reliability of the knowledge test was measured by the Cronbach's alpha coefficient of reliability. Cronbach's alpha was found to be very high ($\alpha$ =0.939) and indicates strong internal consistency among the items. To administer the knowledge test a respondent is given one mark for each correct answer and zero mark for each wrong answer.

**Keywords:** Veterinarians, antimicrobial resistance and stewardship, knowledge-test

## Introduction

Veterinarians have to possess the necessary knowledge to improve attitudes and practices on antibiotic use, antibiotic resistance and its containment. Assessing veterinarian's knowledge on antibiotic resistance and its containment as well as stewardship practices is therefore necessary in order to inform evidence-based interventions. Such evidence-based interventions could curb the emergence and dissemination of antimicrobial resistance, thereby improving animal welfare, sustaining animal production, and safeguarding the future of veterinary medicine and human medicine.

Knowledge is one of the most important elements of behaviour as it exerts an important role in the covert and overt behaviour of an individual. Bloom *et al.* (1956) [2] defined knowledge as those behaviours and test situations that emphasized the remembering either by recognition or recall of ideas, materials or phenomena. Knowledge is a body of understood information possessed by an individual (Bhatt and Patel, 2009) [1]. In this study, knowledge of veterinarians about antimicrobial resistance and stewardship was operationalised as extent of understanding possessed by veterinarians about the concept, cause, prevention and control of antimicrobial resistance as well as the concept and components of antimicrobial stewardship behaviour and antimicrobial stewardship programmes. The knowledge about antimicrobial resistance and stewardship of veterinarians is postulated to directly affect prescribing behaviour.

A knowledge test is a set of questions, each of which has a correct answer, to which people respond (Roy and Mondal, 2004) [9]. An appropriate knowledge test would be advantageous to assessing the level of relevant knowledge of the target population. This paper explains the construction of knowledge test to assess the knowledge of the veterinarians with regard to antimicrobial resistance and stewardship specifically for this study which consisted of the following steps.

**Item collection**

The content of the knowledge test was composed of questions (items). An item pool of questions were prepared by reviewing literature, referring text books and conducting discussions with subject matter specialists and field extension personnel. Finally, a thorough scrutiny of the item pool was done with the assistance of subject matter specialists. The questions were designed to test the knowledge level of veterinarians about antimicrobial resistance and stewardship. The items collected were centered on the concept of antimicrobial resistance, causes of antimicrobial resistance, prevention and control of antimicrobial resistance and concept of antimicrobial stewardship behaviour and components of stewardship programmes. A total of 52 knowledge items were initially prepared.

**Relevancy rating**

These prepared 52 statements were subjected to scrutiny by an expert panel of judges to determine the relevancy and screening for inclusion in the final scale. Judges comprised of faculties from extension education department of all veterinary universities in India. The statements were sent to 150 Judges with request to critically evaluate each statement for its relevancy to measure knowledge level of veterinarians about antimicrobial resistance and stewardship. The judges were requested to give their response on a four-point continuum *viz.*, most relevant, relevant, somewhat relevant and not relevant with scores of four, three, two and one, respectively. Within a time of one month 42 judges returned their responses which were used for relevancy analysis.

The relevancy score of each item was established by adding the scores on the rating scale based on each judge's response. From the data, three types of tests relevancy percentage, relevancy weightage and mean relevancy scores were worked out for all the statements.

The statements which had relevancy percentage more than 75, mean relevancy weightage more than 0.80 and mean relevancy score more than 2.4 were considered for selection. Based on the above criteria a total of 45 statements were selected for item analysis.

**Item analysis**

Item analysis is a process that examines respondent's responses to individual test items (questions) to assess the quality of those items and the test as a whole. The procedure for item analysis was based on a very simple method for what happens when any person encounters any item. The method says that the outcome of such an encounter is governed by the product of the ability of the person and the easiness of the item. The more able the person, the better his chances for success with any item. The easier the item, the more likely that any person to solve it (Wright and Panchapakesan, 1969) [12]. Item analysis is especially valuable in improving items that were used again in later tests, but it can also be used to eliminate ambiguous or misleading items in a single test administration.

The selected 45 statements were sent to a list of 100 non-sample veterinarians in four districts of Kerala *viz*., Palakkad (25), Malappuram (25), Thrissur (25) and Kasaragode (25) comprising 25 respondents from each district with a request to give their response as per their knowledge as "Yes" or "No" for the selected questions for the knowledge test. All the statements collected for the construction of the knowledge test were in the objective form. A total of 60 veterinarians responded and sent their responses within a time of one month. For each correct answer, one mark was assigned and for each wrong answer was scored as zero. The respondent's total knowledge score was calculated by adding the scores of all the questions. The calculated knowledge scores were used to calculate difficulty index, discrimination index and point bi-serial correlation which formed the criteria for selection of the items for the final knowledge test.

**Difficulty index**

The difficulty index indicated the extent to which an item was difficult. An item should not be so easy that all persons can answer it and it should also not be so difficult that no respondent can answer it.

Difficulty index (P-value), also called as ease index, describes the percentage of respondents who correctly answered the item. It ranged from 0 to100 per cent. The higher the percentage the easier the item. The recommended range of difficulty is between 25 and 75 per cent. Items having P-values below 25 per cent and above 75 per cent were considered difficult and easy items respectively (Hingorjo and Jaleel, 2012) [8].

The item difficulty index was worked out in this study as percentage of respondents who answered an item correctly. The difficulty index of each of the 45 items were calculated by dividing the total correct responses for a particular item by the total number of respondents.

The difficulty index was calculated by the following formula

$$\mathrm{Pi} = \frac{\mathrm{ni}}{\mathrm{Ni}} \times 100$$

Where,

Pi = Difficulty index in percentage of the $i^{th}$ item.

ni = Number of respondents giving a correct answer to the $i^{th}$ item.

Ni = Total number of respondents to whom the items were administered.

Items with P values ranging between 25 and 75 per cent were considered for selection in the final knowledge test.

**Discrimination index**

The second criterion applied for item selection was the discrimination index. The purpose of item discrimination index is to assess whether an item discriminates a well-informed respondent from a poorly informed one. Item discrimination goes beyond determining the proportion of people who answer correctly and looks more specifically at who answers correctly. In other words, item discrimination determines whether those who did well on the entire test did well on a particular item.

The statement which is answered correctly by everyone or the one which is not answered by anyone in the sample had no discrimination value. Therefore, only those statements with high power to discriminate the respondents who varied in the level of knowledge were included in the final list.

In order to work out the discrimination index among the respondents for each question which was selected for the final test, the method suggested by Sabarathnam (1987) was adopted as follows.

The total score of the respondents for the 45 knowledge items were arranged in descending order and the respondents were divided into six equal groups, viz., $G_1$, $G_2$, $G_3$, $G_4$, $G_5$ and $G_6$

with 10 respondents in each group.
Further, these six groups were again grouped into three as that with high scores comprising of $G_1$ and $G_2$, groups with medium scores ($G_3$ and $G_4$), group with low scores ($G_5$) and ($G_6$). To get an effective item discriminate index, the middle score group ($G_3$ and $G_4$) was eliminated and the two extreme groups, *i.e.* groups with high scores ($G_1$ and $G_2$) and groups with low scores ($G_5$ and $G_6$) were retained for further analysis. The following formula was used to calculate the discrimination index of each item.

$$DI = \frac{Nhi - Nli}{N/3}$$

Where,
DI = Discrimination index.
Nhi = Number of respondents in high group who had answered the $i^{th}$ item correctly.
Nli = Number of respondents in low group who had answered the $i^{th}$ item correctly.
N = Total number of respondents.

DI = 0 meant that the item had no ability to discriminate respondents, while DI = 1.00 meant that the item had a perfect discrimination ability. Item discrimination of 0.50 or higher was considered as excellent. In the present study, the item with DI value equal to or more than 0.45 was considered for selecting items for inclusion in the final knowledge test.

**Point bi-serial correlation**
A correlation performed between a continuous and a dichotomous variable is known as point-bi-serial correlation (Demirtas and Hedeker, 2016) [3]. Point bi-serial is a product moment correlation that is capable of showing the predictive power that an item has contributed to prediction by estimating the correlation between each item and the total test score of all the examinees (Essen and Akpan, 2018) [4].
For establishing internal consistency of each item, point bi-serial correlation co-efficient ($r_{pbis}$) was estimated. Point bi-serial correlation is the test of item validation in which criterion of validity is considered to be internally consistent, *i.e.*, the relationship of the total score to a dichotomized answer on any given item.
It was calculated by using the formula suggested by Garrett and Woodsworth (1969) [5].

Where,

$$r_{pbis} = \frac{Mp - Mq}{SD} \times pq$$

$r_{pbis}$ = Point bi-serial correlation.
Mp = Mean of the total scores of the respondents who answered the item correctly.
Mq = Mean of the total scores of the respondents who answered the item incorrectly.
SD = Standard deviation of the entire sample.
p = Proportion of the respondents giving correct answer to the item.
q = Proportion of the respondents giving incorrect answer to the item (or) q =1-p.

All the point bi-serial r values were calculated and the corresponding't' values were worked out with the help of Table 51 of Garrett, (2011) at n-2 degrees of freedom (d.f.) i. e. at 58 d.f. The't' value for 58 d.f. as per the table at 5 per cent is 0.237 and at 1 per cent is 0.354.
Hence, items with $r_{pbis}$ values equal to or more than 0.237 at 5 per cent level were considered for the final knowledge test.

**Final selection of the items for the test**
All the items that had a difficulty index ranging from 0.25 to 0.75, discrimination index above 0.45 and point bi-serial correlation value that was significant at 5 per cent level of significance were selected for the final knowledge test. Twenty items fall in this category.

**Table 1:** Statements selected for the knowledge test

| SL. No. | Statements | Answer |
|---|---|---|
| | **I. Concept of antimicrobial resistance** | |
| 1. | Both bacteria and viruses can become resistant to antibiotics. | Yes/No |
| 2. | Both beneficial and harmful bacteria can become resistant to antibiotics. | Yes/No |
| 3. | Bacteria will become resistant if they are exposed to an antibiotic on one instance only. | Yes/No |
| 4. | Healthy animals can be carriers of resistant organisms. | Yes/No |
| 5. | A resistant bacterium cannot spread between animals and humans. | Yes/No |
| | **II. Causes of antimicrobial resistance** | |
| 6. | Use of the same antimicrobials in veterinary and human practice increases the chances for antimicrobial resistance. | Yes/No |
| 7. | Sub-standard, fake, non-approved antimicrobials do not contribute to development of antimicrobial resistance. | Yes/No |
| 8. | Environmental contamination with antibiotic waste from hospitals and pharmaceutical industry will lead to the development of resistance. | Yes/No |
| 9. | Use of too many broad-spectrum antimicrobials will result in the development of resistance. | Yes/No |
| 10. | Poor infection control practices in health care settings increases the spread of resistant organisms. | Yes/No |
| | **III. Prevention and Control of antimicrobial resistance** | |
| 11. | Use of narrow spectrum antibiotics for specific infections reduces development of antimicrobial resistance. | Yes/No |
| 12. | Newer generation antibiotics can rapidly solve the problem of antimicrobial resistance. | Yes/No |
| 13. | Making better use of existing vaccines will help to tackle antimicrobial resistance. | Yes/No |
| 14. | Using combinations of antibiotics can help to prevent antimicrobial resistance. | Yes/No |
| 15. | Practicing good animal hygiene will prevent development of resistance. | Yes/No |
| | **IV. Antimicrobial Stewardship** | |
| 16. | The main goal of antimicrobial stewardship is to decrease the use of antibiotics. | Yes/No |
| 17. | Increasing the duration of antibiotic therapy to ensure therapeutic success is stewardship behaviour. | Yes/No |
| 18. | Antimicrobial stewardship should be incorporated at the level of pharmacy. | Yes/No |

| | | |
|---|---|---|
| 19. | Antimicrobial stewardship programmes should involve all stakeholders. | Yes/No |
| 20. | Veterinarians are the only professionals responsible in an antimicrobial stewardship programs. | Yes/No |

**Standardization of the scale**

**Validity of the knowledge test**

The validity of the knowledge test was established through content validity. The content validity of the knowledge test was ensured by choosing items in consultation with various subject matter specialists. All possible care was taken while selecting the items and the same was subjected to difficulty and discrimination index and point bi-serial correlation, to select the final statements. Hence, it was logical to assume that the test satisfied representative approach of test construction, the criteria for content validity.

**Reliability of the knowledge test**

Reliability concerns the extent to which the measurement of a phenomenon provides a stable and consistent result. Reliability is also concerned with repeatability (Taherdoost, 2016) [11]. A measure should produce similar or the same results consistently if it measures the same thing again and again. Reliability is determined by the consistency with which a test measures that which it does measure (Sarmah and Hazarika, 2012) [10].

The reliability of the knowledge test was assessed by calculating the cronbach's alpha coefficient of reliability. For this the knowledge test was administered to 40 non-sample veterinarians who were selected randomly from Kannur (20) and Kozhikode (20) districts of Kerala. They were asked to give their responses to the 20 test statements of the knowledge test. The collected data were tabulated and analysed to estimate the alpha value. The formula for calculating the alpha value is as follows.

$$A = \frac{K}{K-1}\left(\frac{\sum_i{}^{K}{}_{=1}\, \sigma^2 y_i}{\sigma^2 x}\right)$$

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.

SPSS software version 26 was used to calculate the alpha value.

| Reliability Statistics | |
|---|---|
| **Cronbach's alpha** | **No. of items** |
| 0.939 | 20 |

**Table 2:** Cronbach's alpha test results for internal consistency of knowledge test

| Items | Scale mean if item deleted | Scale variance if item deleted | Corrected item-total correlation | Cronbach's alpha if Item deleted |
|---|---|---|---|---|
| Item 1 | 30.52 | 40.35 | 0.498 | 0.908 |
| Item 2 | 30.55 | 40.66 | 0.433 | 0.919 |
| Item 3 | 30.50 | 41.33 | 0.339 | 0.890 |
| Item 4 | 30.65 | 38.54 | 0.759 | 0.913 |
| Item 5 | 30.82 | 39.32 | 0.632 | 0.926 |
| Item 6 | 30.55 | 39.33 | 0.664 | 0.915 |
| Item 7 | 30.70 | 37.65 | 0.903 | 0.921 |
| Item 8 | 30.52 | 39.79 | 0.598 | 0.896 |
| Item 9 | 30.57 | 39.53 | 0.616 | 0.916 |
| Item 10 | 30.67 | 38.12 | 0.825 | 0.902 |
| Item 11 | 30.60 | 40.40 | 0.460 | 0.909 |
| Item 12 | 30.57 | 40.19 | 0.502 | 0.918 |
| Item 13 | 30.65 | 38.54 | 0.759 | 0.923 |
| Item 14 | 30.82 | 39.32 | 0.632 | 0.906 |
| Item 15 | 30.55 | 39.33 | 0.664 | 0.925 |
| Item 16 | 30.70 | 37.65 | 0.903 | 0.901 |
| Item 17 | 30.52 | 39.79 | 0.598 | 0.916 |
| Item 18 | 30.57 | 39.53 | 0.616 | 0.896 |
| Item 19 | 30.67 | 38.12 | 0.825 | 0.902 |
| Item 20 | 30.52 | 40.35 | 0.498 | 0.898 |

The Cronbach's alpha was found to be 0.939, which indicated strong internal consistency among the 20 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 2, 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 2, correlation between item 1 and the summated score of items 2 to 20 was r = 0.498. This indicated that, there was a positive correlation between the scores on the one item (Item1) and the combined score of the remaining items (item 2 to item 20). The rule-of-thumb is that these values should be at least 0.40 (Gliem and Gliem, 2003) [7].

In Table 2, 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. It shows that, the alpha value if the given item were not included among the set of items. For example, In Table 2, the cronbach's alpha of the scale would drop from the overall total of 0.939 to 0.908, if item 1 were removed from the scale. It explains that the alpha would drop with the removal of first statement, which thus appears to be useful and 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 excellent, indicating a strong internal consistency among the set of 20 items, and that the items used in the scale were appropriate and reliable. The reliability of the test was thus confirmed.

**Administration of the scale**

The developed knowledge test can be administered to the respondents in order to elicit their knowledge level about antimicrobial resistance and stewardship. Each respondent can be given a score of 'one' for a correct answer and 'zero' for an incorrect response. The summation of scores for correct replies to all the items of the knowledge test of a particular respondent indicates his/her knowledge score. The knowledge score for an individual would range from a minimum of 0 to a maximum of 20. Based on the total scores obtained, the respondents can be categorized into as those having high, medium and low knowledge. A higher score indicated that the respondent had a better knowledge about antimicrobial resistance and stewardship and vice-versa.

**Conclusion**

In this study, the universe of statements were derived from extensive review of literature and discussion with subject experts as well as 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. The present developed test shows better reliability and has strong and positive correlation between all the items, so there is no need to re-examine and modify the individual items for further investigation. The test so developed can be used for assessing the knowledge level of veterinarians on antimicrobial resistance and stewardship. Based on the knowledge levels the strategies could be chalked out for implementing interventions for antimicrobial resistance containment. This scale can be used to measure the veterinarian's knowledge on antimicrobial resistance and stewardship beyond the study area with suitable modifications.

**References**

1. Bhatt PM, Patel HB. A scale to measure knowledge of dairy farmers regarding improved animal husbandry practices. Gujarat Journal of Extension Education, 2009, 20-21, 11-14.
2. Bloom BS, Enoatharadt M, Furst S, Hill W, Krathahob DR. Taxonomy of Educational objectives-The cognitive, domine, Longmans Green and Co. New York, 1956.
3. Demirtas H, Hedeker D. Computing the point-biserial correlation under any underlying continuous distribution. Communications in Statistics-Simulation and Computation. 2016;45(8):2744-2751.
4. Essen C, Akpan G. Analysis of difficulty and point biserial correlation indices of 2014 Akwa Ibom State Mock Multiple Choices Mathematics Test. International Journal of Education and Evaluation. 2018;4(5):1-11.
5. Garrett EH, Woodworth RS. Statistics in psychology and education. Vakils, Feffer and Simons Pvt. Ltd., Bombay, 1969, 329.
6. George D, Mallery P. SPSS for Windows Step by Step: A Simple Guide and Reference. 11.0 Update (4th ed.). Boston: Allyn & Bacon, 2003.
7. Gliem JA, Gliem RR. Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Paper Presented at the Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education, Columbus, OH: The Ohio State University, 2003 Oct.
8. Hingorjo MR, Jaleel F. Analysis of one-best MCQs: the difficulty index, discrimination index and distractor efficiency. JPMA-Journal of the Pakistan Medical Association. 2012;62(2):142.
9. Roy GL, Mondal S. Research methods in social sciences and extension education. 2nd ed. Kalyani Publishers, Ludhiana, 2004.
10. Sarmah HK, Hazarika B. Determination of Reliability and Validity measures of a questionnaire. Indian Journal of Education and Information Management. 2012;1(11):507-517.
11. Taherdoost H. Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. How to test the validation of a questionnaire/survey in a research, 2016 Aug.
12. Wright B, Panchapakesan N. A procedure for sample-free item analysis. Educational and Psychological measurement. 1969;29(1):23-48.