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Drivers of antibiotic prescription and practitioner profiles: A cross-sectional survey of veterinarians in central Kerala, India

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Abstract

Antimicrobial resistance (AMR) is a significant One Health challenge, with veterinary antibiotic use being a key contributing factor. This study aimed to assess the knowledge, attitudes, and practices (KAP) regarding antibiotic prescription among veterinarians in central Kerala, India. A cross-sectional survey was conducted among 150 practitioners using a structured questionnaire. Results revealed that clinical signs were the most dominant factor influencing antibiotic choice, rated as having a 'strong' influence by 83% of respondents. Tetracyclines were the most frequently prescribed antibiotic class. Treatment failure was the primary reason for changing an antibiotic prescription (74.7%), with limited reliance on culture and sensitivity testing (15.1%). Multivariate analysis identified three distinct practitioner profiles: 'the evidence-driven steward,' 'the pragmatist,' and 'the experience-based clinician'. While self-reported adherence to infection control is high, the findings highlight a critical need to promote diagnostic-led prescribing to foster prudent antibiotic stewardship in veterinary practice.

Keywords: Antimicrobial Resistance, Veterinary Practice, KAP Survey, Antibiotic Stewardship, Kerala, One Health

1. Introduction

Antimicrobial resistance (AMR) represents one of the most pressing global public health threats of the 21st century. The interconnectedness of human, animal, and environmental health, encapsulated by the One Health concept, underscores that the use of antimicrobials in any single domain can drive the emergence and spread of resistant pathogens across all sectors¹. The World Health Organization (WHO) has highlighted the particular threat posed by "ESKAPE" pathogens (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* species), many of which are of concern in both human and veterinary medicine.

The quantity of antimicrobials used in food-producing animals is substantial and is correlated with rising AMR rates globally². Veterinarians, as the gatekeepers of antimicrobial use in animals, play a pivotal role in combating AMR. Their prescribing decisions are complex, influenced by a combination of clinical factors, diagnostic capacity, client expectations, and economic pressures³. Understanding the knowledge, attitudes, and practices (KAP) of veterinarians is therefore essential for developing effective antibiotic stewardship programs⁴.

In India, the regulation and monitoring of veterinary antimicrobial use face significant challenges. While national action plans on AMR are in place, data on prescription patterns and their underlying drivers at the regional level are scarce. This study was therefore designed to assess the KAP of veterinary practitioners in central Kerala, a region with a high density of livestock and companion animal populations, regarding antibiotic use, AMR, and infection control. The primary objective was to identify the key factors influencing antibiotic prescription and to segment practitioners into distinct profiles based on their decision-making attitudes, providing evidence for targeted stewardship interventions.

2. Materials and Methods

2.1 Study Area and Period

The study was conducted in three central districts of Kerala, India: Thrissur, Ernakulam, and Idukki. This region was selected due to its diverse mix of small-animal, large-animal, and mixed veterinary practices. The survey was carried out over a period of 13 months, from March 2024 to March 2025.

2.2 Study Design and Sampling

A cross-sectional survey design was employed to collect data on the KAP of veterinarians. From an estimated population of 750 veterinarians practicing in the study area, a sample of 150 practitioners was selected using a convenience sampling method.

2.3 Data Collection Instrument

Data were collected using a pre-tested, structured questionnaire. The questionnaire was administered through in-person interviews and via a digital link using Google Forms. The instrument was divided into four main sections:

- 1. Demographic Details:** Information on gender, age, years of professional experience, type of practice, and daily caseload.
- 2. Antibiotic Use and Prescription:** Questions on the frequency of prescribing various antibiotic classes and the perceived influence of 16 different factors on prescription choice.
- 3. Clinical Case Details:** Information on common clinical scenarios requiring antibiotics and reasons for changing prescriptions.
- 4. Infection Prevention and Control (IPC) Practices:** Assessment of self-reported adherence to seven key IPC measures.

2.4 Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of the College of Veterinary and Animal Sciences, Mannuthy. Informed consent was obtained from all participating veterinarians prior to their inclusion in the study. The confidentiality and anonymity of the respondents were

maintained throughout the research process.

2.5 Statistical Analysis

Data from the completed questionnaires were coded, entered into a spreadsheet, and analysed using statistical software IBM SPSS Statistics for Windows, Version 24.0 (IBM Corp., New York, USA), while advanced multivariate ecological analyses and specialised data visualisations were generated using R software (Version 4.4.2- R Foundation for Statistical Computing, Vienna, Austria) with the RStudio IDE, employing packages such as vegan, dplyr, ggplot2 and ggraph. Descriptive statistics, including frequencies and percentages, were used to summarize the socio-demographic characteristics and KAP responses. A non-parametric Friedman rank-sum test was used to compare the ranked importance of different prescription-influencing factors and IPC practices. Pearson's Chi-Square test was used to assess associations between categorical variables, such as practice type and the decision to collect samples for testing.

To explore the underlying patterns in prescribing attitudes, multivariate analyses were employed. Multiple Correspondence Analysis (MCA) was used to reduce the dimensionality of the 16 prescription-influencing factors and visualize their relationships. Following this, a k-Means Cluster Analysis was performed on the MCA dimensions to segment the practitioners into distinct groups based on their prescribing attitudes. A p-value of less than 0.05 was considered statistically significant for all tests.

3. Results

3.1 Socio-demographic Profile of Respondents

A total of 150 veterinary practitioners participated in the survey. The demographic characteristics of the respondents are presented in Table 1. The cohort comprised more females (56.7%) than males (43.3%). The majority of practitioners (82.0%) engaged in a mixed practice serving both small and large animals, categorized as 'Not specific'. A substantial portion of the respondents (42.7%) had more than ten years of professional experience. The median age was 36.0 years, and the median daily caseload was in the category of 11-20 cases.

Table 1: Socio-demographic characteristics of surveyed Veterinary Practitioners (N=150)

Characteristic	Category	Number (n)	Percentage (%)
Gender	Female	85	56.7
	Male	65	43.3
Type of Practice	Small-Animal Practitioner only	14	9.3
	Large-Animal Practitioner only	8	5.3
	Not specific	123	82.0
	Other	5	3.3
Years of Experience	Less than 2 years	31	20.7
	2 to 5 years	35	23.3
	5 to 10 years	20	13.3
	More than 10 years	64	42.7

3.2 Factors Influencing Antibiotic Prescription

Practitioners were asked to rate the influence of 16 factors on their antibiotic prescription decisions. As shown in Figure 1, 'clinical signs' was the most significant driver, with 83% of respondents rating it as having a 'strong' influence. Other factors with high perceived influence included 'antibiotic spectrum' (61% strong) and 'duration of therapy' (59% strong). Conversely, 'pharmaceutical offers' (8% strong), 'lack of time' (12% strong), and 'owner demand' (29% strong) were rated as less influential. A Friedman rank-sum test confirmed that the perceived importance of these factors varied

significantly ($\chi^2(15) = 1254.7$, $p < 0.001$), indicating a clear hierarchy in decision-making criteria.

With regard to the frequency of use, practitioners reported their estimated monthly prescribed doses for various antibiotic classes (Figure 2). While most antibiotics were prescribed in the 0-10 doses/month category, tetracyclines and fluoroquinolones showed a higher proportion of use in the 11-50 doses/month range. In contrast, carbapenems were the least prescribed class, with almost all respondents reporting their use in the 0-10 doses/month category, indicating infrequent use consistent with their status as last-resort antibiotics.

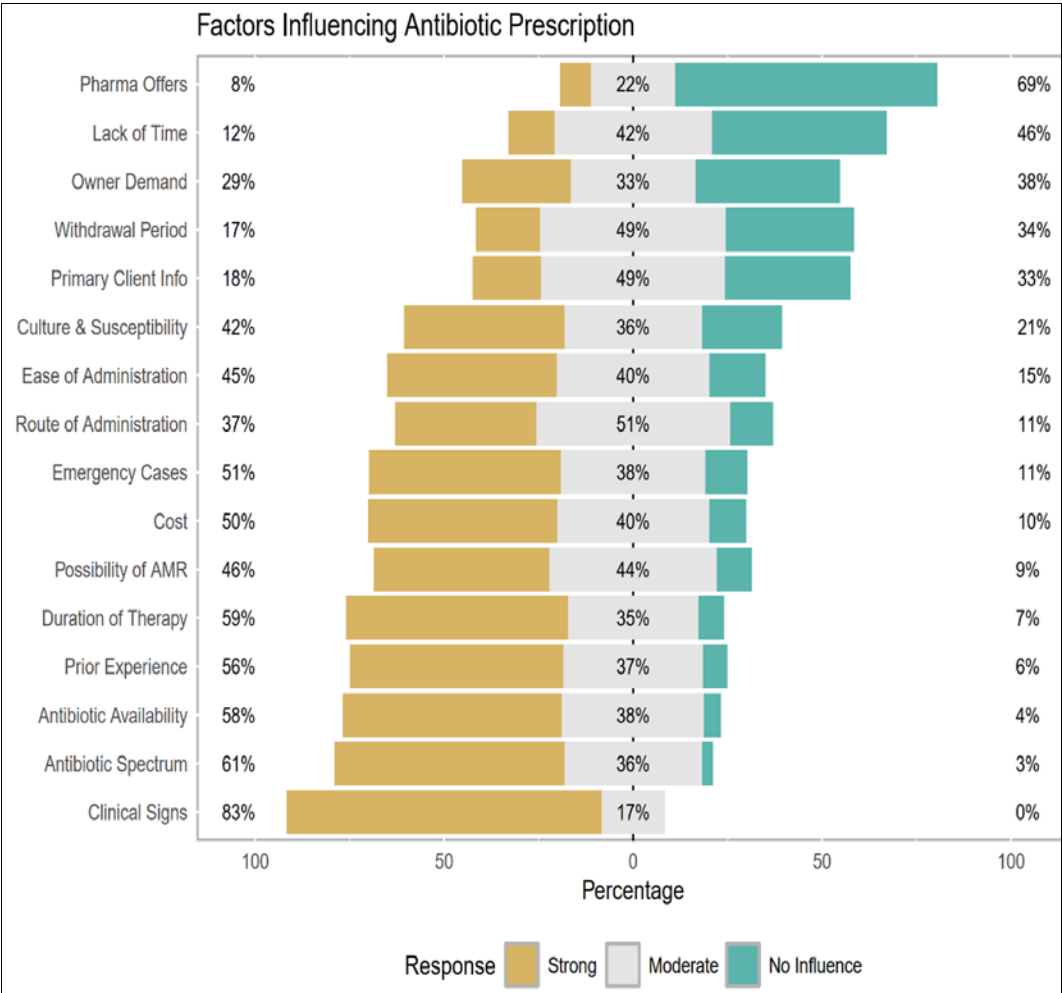


Fig 1: Bar chart showing the rated influence of various factors on antibiotic prescription decisions by veterinary practitioners (N=150).

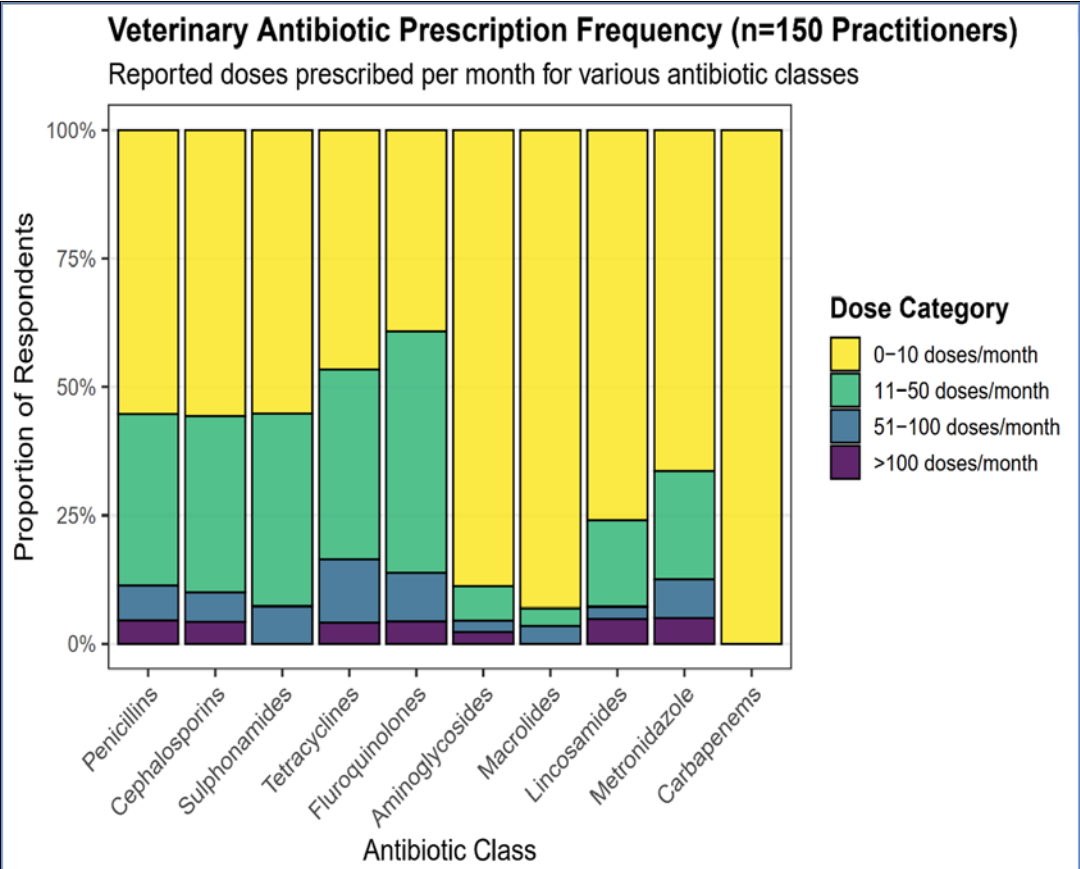


Fig 2: Stacked bar chart of the reported frequency of antibiotic doses prescribed per month for various antibiotic classes by veterinary practitioners (N=150).

3.3 Clinical Decision-Making in Practice

When presented with clinical scenarios, a large majority of practitioners reported that conditions such as pyrexia (90.5%) and mastitis (87.5%) prompted high antibiotic use. A significant finding was that while 93.3% of practitioners reported having to change an antibiotic prescription during treatment, the primary driver for this change was a lack of clinical response to the initial treatment (74.7%). Conversely, guidance from antibiotic susceptibility test (AST) results was a far less common reason, cited by only 15.1% of respondents.

3.4 Infection Prevention and Control (IPC) Practices

Self-reported adherence to key IPC practices was exceptionally high among the surveyed veterinarians (Figure 3). Practices such as 'instrument disinfection' and 'table disinfection' were reported as 'always' performed by 100% of respondents, with 'hand washing' at 99%. Adherence to 'use of personal protective equipment (PPE)' was slightly lower but still high, with 93% reporting they 'always' use it. A Friedman test confirmed a statistically significant difference in the reported adherence frequencies across the seven practices ($\chi^2(6) = 69.69$, $p < 0.001$), suggesting minor variations in consistency despite the overall high compliance.

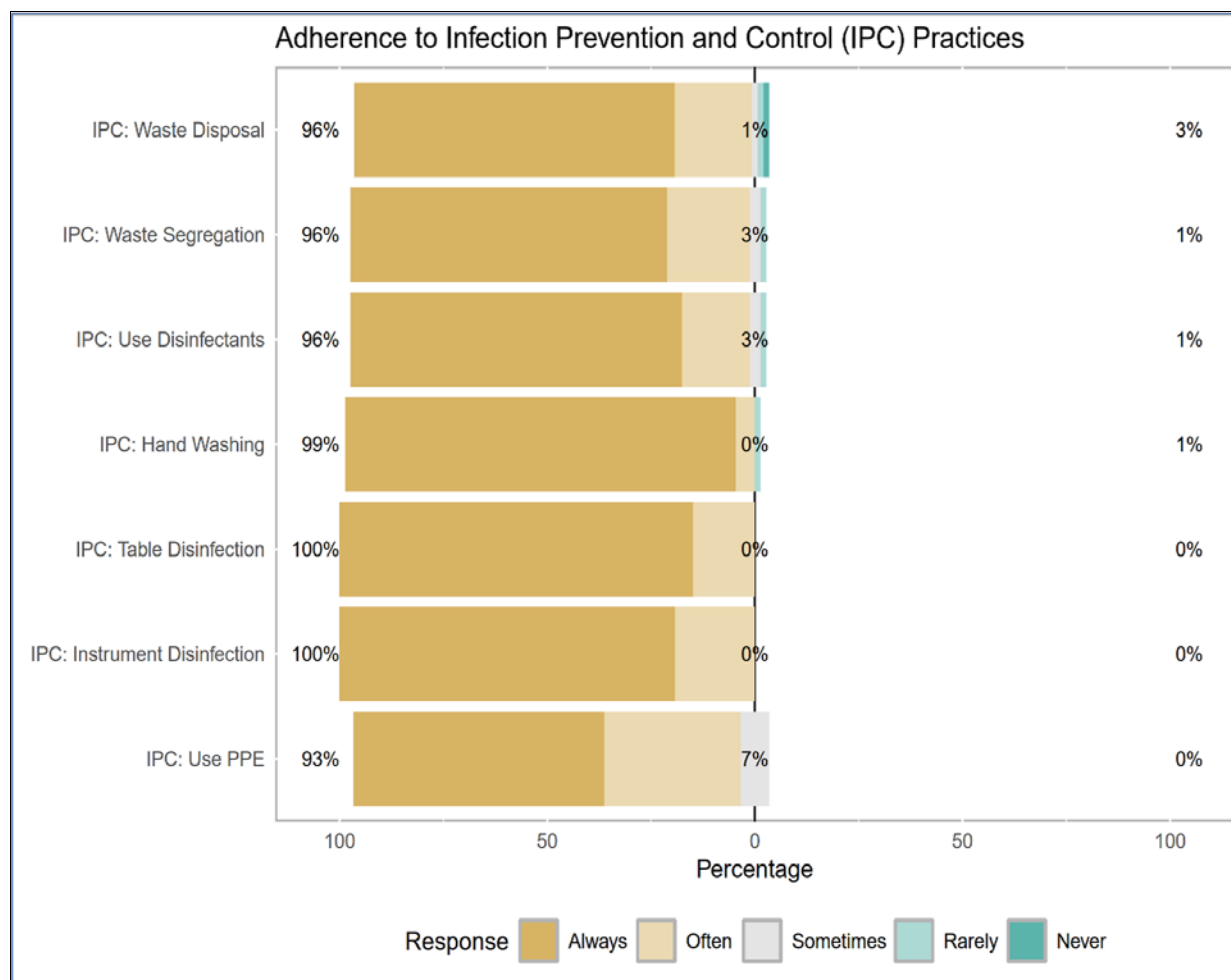


Fig 3: Bar chart summarizing self-reported adherence to key Infection Prevention and Control (IPC) practices by veterinary practitioners (N=150).

3.5 Statistical Associations and Practitioner Profiling

Inferential analysis revealed several significant associations between practitioner characteristics and their practices (Table 2). A Chi-Square test showed a significant relationship between the 'type of practise' and the 'decision to collect samples for AST' ($\chi^2(3) = 11.62$, $p = 0.0088$). Practitioners specializing in small-animal practice were more inclined to use diagnostic testing compared to their counterparts in large-animal or non-specific practice.

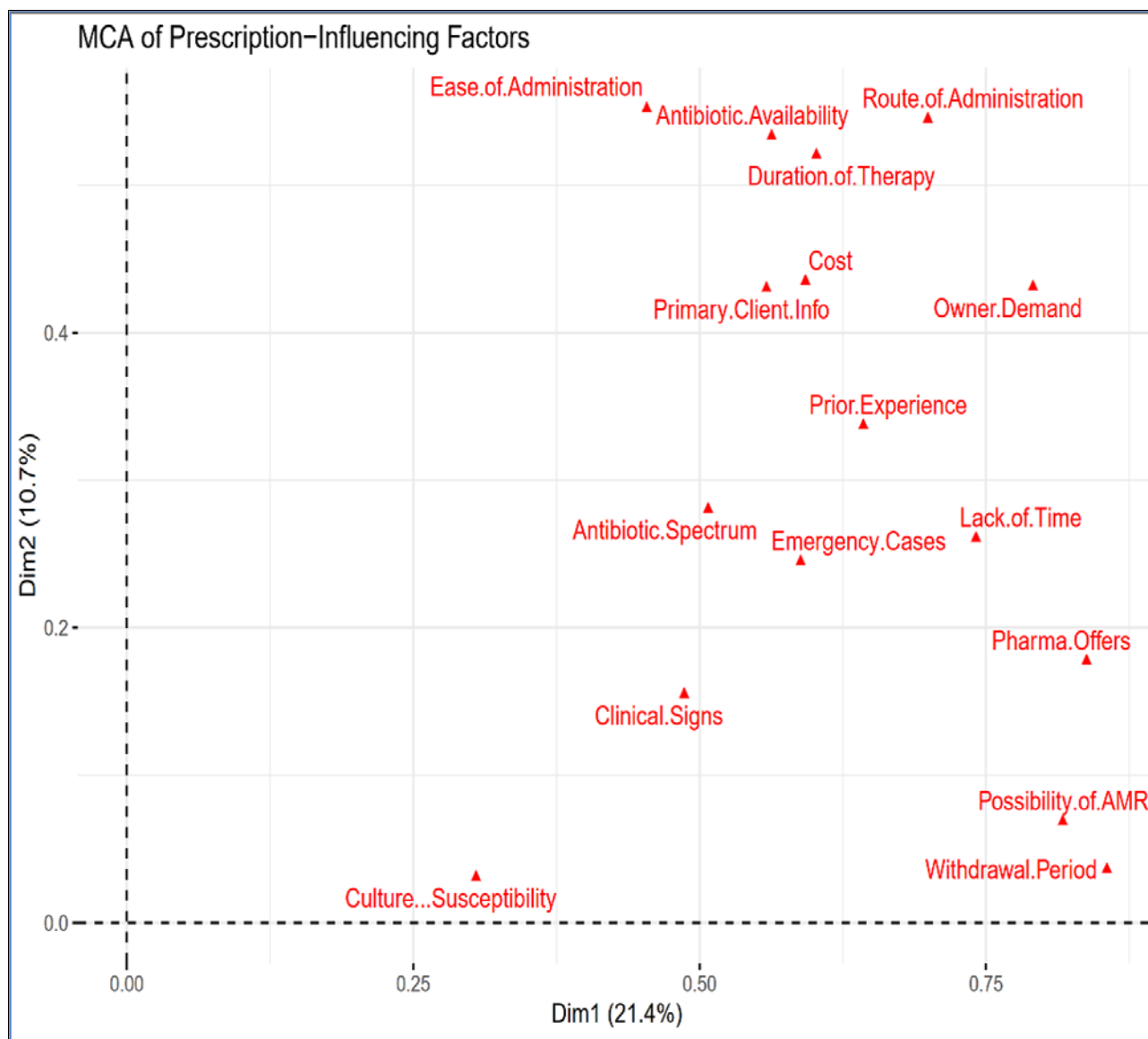
To delve deeper into prescribing attitudes, a Multiple Correspondence Analysis (MCA) was performed on the 16 influencing factors. The analysis successfully reduced the complexity into two primary dimensions that collectively explained 32.1% of the total variance (Figure 4). These dimensions were interpreted as representing a continuum

from "evidence-based stewardship vs. pragmatic pressures" and "practical convenience vs. clinical considerations". Building on this, a k-Means Cluster Analysis segmented the 150 practitioners into three distinct groups based on their prescribing attitudes (Figure 5). These segments were characterized as:

- **Group 1: The Evidence-Driven Steward:** Practitioners whose decisions are strongly influenced by factors like culture/susceptibility results and AMR potential.
- **Group 2: The Pragmatist:** Practitioners influenced by practical and economic factors such as cost, client demand, and drug availability.
- **Group 3: The Experience-Based Clinician:** Practitioners who rely heavily on prior experience, clinical signs, and emergency context.

Table 2. Summary of significant statistical associations from KAP survey analysis.

Variable 1	Variable 2	Test Used	Test Statistic	p-value	Brief Description of Association
Perceived Influence of 16 Prescription Factors	(Within-group comparison)	Friedman Test	$\chi^2(15) = 1254.7$	<0.001	There is a statistically significant difference in how practitioners rank the importance of various factors when prescribing antibiotics.
Reported Adherence to 7 IPC Practices	(Within-group comparison)	Friedman Test	$\chi^2(6) = 69.69$	<0.001	There is a statistically significant difference in the self-reported frequency of adherence across different IPC practices.
Type of Practice	Decision to Collect Samples for ABST	Pearson's Chi-Square	$\chi^2(3) = 11.62$	0.0088	Practitioners in specialized (Small-Animal, Other) practices are significantly more likely to send samples for testing than those in other practice types.

**Fig 4:** Multiple Correspondence Analysis (MCA) plot of factors influencing antibiotic prescription, showing the relationship between variables along two primary dimensions.

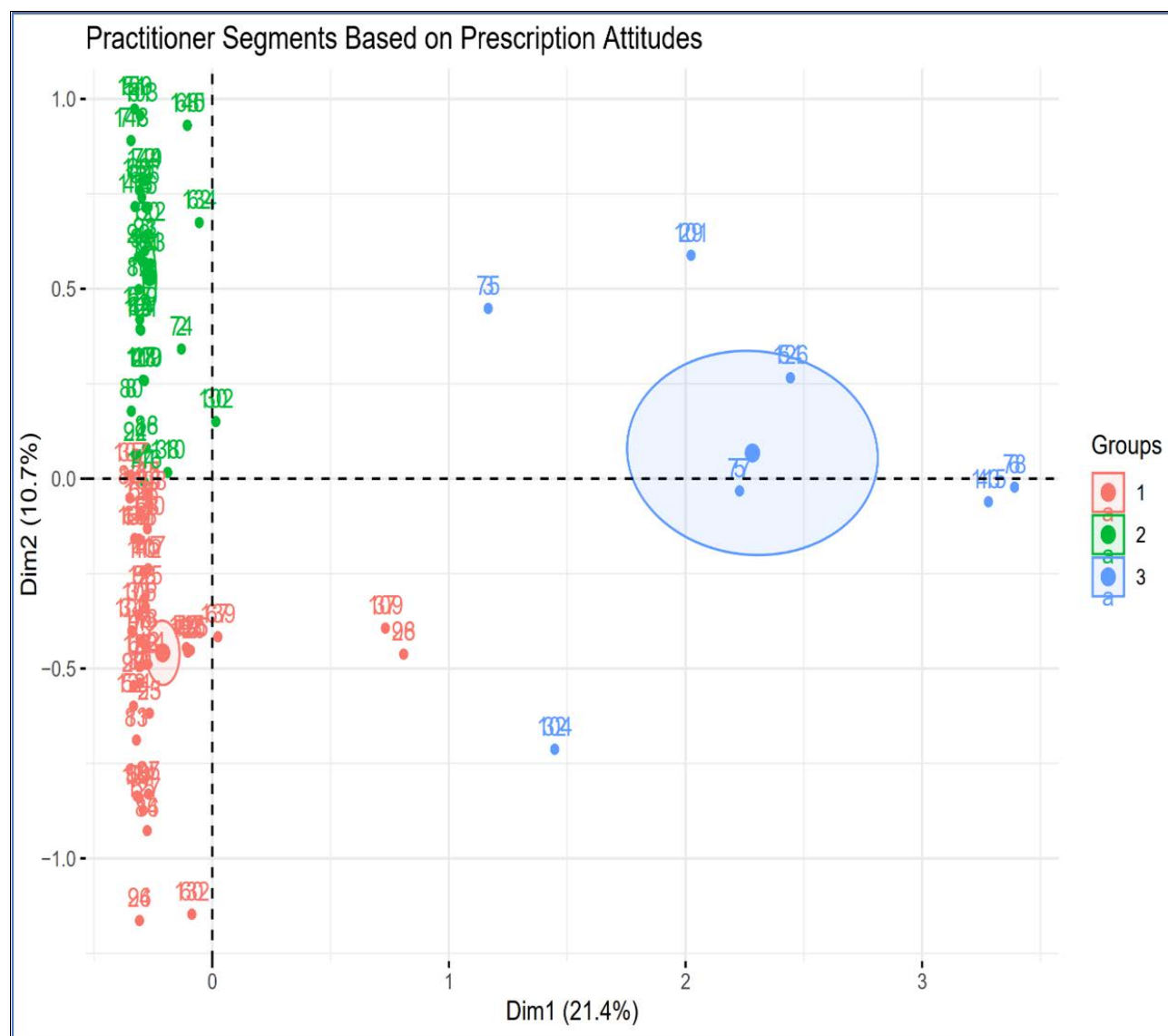


Fig 5: Plot showing the segmentation of 150 veterinary practitioners into three distinct clusters based on their prescribing attitudes revealed by MCA.

4. Discussion

This study provides valuable insights into the antibiotic prescription behaviours of veterinarians in central Kerala, India. The overwhelming reliance on clinical signs for antibiotic selection, while understandable in many field settings, highlights a significant gap in diagnostic-led prescribing. This finding is consistent with other studies in low- and middle-income countries, where access to rapid and affordable diagnostics remains a major barrier to optimal antimicrobial stewardship⁵. The low reported influence of culture and susceptibility test results (42% 'strong' influence) on prescribing decisions is a point of concern, as empirical treatment without diagnostic confirmation can contribute to therapeutic failure and the selection for resistant bacteria.

The prescription patterns, with high reported use of older, broad-spectrum antibiotics like tetracyclines, likely reflect a combination of factors including cost, availability, and their effectiveness against common pathogens in the region. The minimal use of last-resort antibiotics such as carbapenems is a positive finding and aligns with global stewardship principles advocating for their preservation. However, the primary reason for changing a prescription being treatment failure rather than AST guidance underscores a reactive rather than proactive approach to managing infections.

A key finding of this study is the significant association

between practice type and the use of diagnostic tests, with small-animal practitioners being more likely to collect samples for AST. This may be attributable to better access to laboratory infrastructure, higher client willingness to pay for diagnostics in companion animal medicine, and a different spectrum of clinical cases. This disparity suggests that stewardship interventions may need to be tailored differently for large-animal versus small-animal practitioners.

The most novel contribution of this work is the segmentation of veterinarians into three distinct profiles: the 'evidence-driven steward', the 'pragmatist', and the 'experience-based clinician'. This moves beyond a monolithic view of prescriber behaviour and suggests that a one-size-fits-all educational approach to AMR is unlikely to be effective. For instance, 'stewards' may be early adopters of new diagnostic technologies, whereas 'pragmatists' may be more responsive to interventions that address economic or client-related pressures. 'Experience-based clinicians' might benefit most from continuing education that translates evidence-based guidelines into practical, case-based learning⁶.

Finally, while the high self-reported adherence to IPC practices is encouraging, these findings should be interpreted with caution due to the potential for social desirability bias in survey responses.

This study is subject to certain limitations. The use of

convenience sampling may limit the generalizability of the findings, and the self-reported nature of the data is subject to recall and social desirability biases. Despite these limitations, the study provides a robust, data-driven foundation for understanding veterinary prescribing behaviour in the region.

under the identical terms.

5. Conclusion

Veterinary practitioners in central Kerala demonstrate a strong reliance on clinical experience when prescribing antibiotics, with a significant gap in the utilization of antimicrobial susceptibility testing to guide therapeutic choices. While knowledge of IPC appears high, the prevailing practice of empirical treatment presents a challenge for effective antimicrobial stewardship. The identification of distinct prescriber profiles—stewards, pragmatists, and experience-based clinicians—provides a critical framework for designing and implementing targeted educational and policy interventions. Fostering a shift towards evidence-based, diagnostic-led veterinary medicine is essential to preserving antimicrobial efficacy for the future of both animal and human health.

6. Acknowledgement

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