JOURNAL OF VETERINARY AND APPLIED SCIENCES
VOLUME 16, ISSUE 1: 1384 – 1403 (2026)
Published by: Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria
ISSN: 2315-6856; e-ISSN: 2636-5553; Website: www.jvasonline.com

Appraisal of the nutritional and microbiota management practices of Nigerian veterinary clinicians when parvoviral enteritis occurs in dogs

Babatunde I. Olowu [1 *], Abdulhakeem O. Azeez [2], Oluwaloni B. Tinubu [1], Nahimah O. Idris [2], Al-Amin A. Olojede [1], Maryam E. Zakariya [3], Halima Muhammad [4], Mahmudah A. Akande [5], Esther N. Ibeh [6], Augustine I. Tonga [7], Olumuyiwa A. Adejumobi [5] and Daniel O. Oluwayelu [1]

[1] Department of Veterinary Microbiology, Faculty of Veterinary Medicine, University of Ibadan, Nigeria.
[2] Department of Veterinary Microbiology, Faculty of Veterinary Medicine, University of Ilorin, Nigeria.
[3] Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Ilorin, Nigeria.
[4] Department of Veterinary Pharmacology and Toxicology, Faculty of Veterinary Medicine, University of Abuja, Nigeria.
[5] Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of Ibadan, Nigeria.
[6] Department of Veterinary Surgery, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria.
[7] Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria.

==

Abstract

Canine parvoviral enteritis (CPE) remains a major cause of morbidity and mortality in Nigerian dogs, yet the application of global evidence-based management protocols for the disease in local clinical settings is poorly documented. Although international guidelines emphasize early enteral nutrition and microbiota modulation as cornerstones of CPE management, their uptake among Nigerian veterinary clinicians has not been systematically evaluated across the years. This cross-sectional survey assessed the nutritional and microbiota management practices of 109 veterinary clinicians in Nigeria during CPE treatment. A structured questionnaire captured socio-demographic data and self-reported practice patterns, scored on a 0 – 4 ordinal scale and categorized into performance tiers. Most respondents were small-animal practitioners (53.2%) and early-career veterinarians (0 – 5 years: 58.7%). Nutritional management status (NMS) was predominantly "Average" (60.6%), reflecting moderate adoption of early enteral feeding (63.3%) and consistent electrolyte therapy, while gut-barrier supportive diets were inconsistently applied. Microbiota management status (MMS) was "Average" in 45.9% of clinicians, with limited probiotic use (24.7%) and rare faecal microbiota transplantation (FMT; ≤ 31.2%). NMS and MMS were positively correlated ($r = 0.379$, $p < 0.01$), indicating that clinicians with better nutritional practices also demonstrated superior microbiota management. These findings reveal strong awareness of evidence-based CPE management principles but inconsistent implementation of these practices, which underscore the need for standardized, resource-adaptable CPE management frameworks in Nigeria and comparable low- and middle-income country settings.

Keywords: Canine parvoviral enteritis; Nutritional and microbiota management practices; Intestinal microbiota restoration; Veterinary clinicians; Survey; Nigeria.

*** Correspondence:** Babatunde I. Olowu; Email: babatunde.olowu@wsu.edu; Phone: +2348084574866

Article History: Initial manuscript submission received – February 27, 2026; Final revised form received – April 21, 2026; Accepted for publication – April 26, 2026; Published – April 30, 2026.

Introduction

Gastroenteritis remains a major health concern in companion animals worldwide (Mylonakis *et al*., 2016), with canine parvoviral enteritis (CPE) being a leading cause of morbidity and mortality in dogs, particularly unvaccinated puppies (Mazzaferro, 2025; Sato-Takada *et al*., 2022). CPE is caused by canine parvovirus type 2 (CPV-2), a small, non-enveloped, single-stranded DNA virus that targets rapidly dividing intestinal and bone marrow cells, resulting in severe gastrointestinal and haematological disorders (Sato-Takada *et al*., 2022). Affected dogs typically develop fever, vomiting, diarrhea and marked leucopenia, while mucosal damage and immune suppression promote malabsorption, bacterial translocation and systemic inflammation that may culminate in septic shock (Inbaraj *et al*., 2023).

The CPV-2 has been reported to exhibit exceptional environmental resilience and a broad host range, infecting domestic dogs and wild carnivores such as raccoons, cats, coyotes and wolves (Mazzaferro, 2025). The virus remains viable for over a year under favorable conditions and is transmitted primarily via oro-nasal exposure, when naïve, susceptible or inadequately immunized dogs ingest viral particles shed in the vomitus or faeces of infected animals (Mylonakis *et al*., 2016). Following replication in lymphoid tissues, viraemia develops within 1 – 5 days of exposure (Mazzaferro, 2025). The CPV-2 targets cells in the intestinal crypts, bone marrow, oral mucosa, and cardiac myocytes, as well as those in the lungs, liver, spleen and kidneys (Ford *et al*., 2017). The resulting enterocyte loss, thymic collapse and marrow suppression cause marked leucopenia, while endotoxins and pro-inflammatory cytokines promote systemic inflammation and coagulation activation (Inbaraj *et al*., 2023).

Clinical diagnosis of CPE is complicated by its non-specific gastrointestinal manifestations, which overlap with those of other viral enteritides, including coronaviruses, adenoviruses, morbilliviruses, rotaviruses, reoviruses, and noroviruses (Decaro *et al*., 2020). Confirmatory diagnosis, therefore, relies on laboratory testing, with serological and molecular assays providing rapid and sensitive detection (Nandi and Kumar, 2010). Vaccination remains the principal preventive measure; however, viral persistence has been reported globally, including in Nigeria, despite extensive immunization coverage (Decaro *et al*., 2020; Ogbu *et al*., 2021). Breakthrough infections in vaccinated dogs contribute to substantial economic losses and reflect potential antigenic drift, inadequate herd immunity or procedural lapses in field vaccination (Ukwueze *et al*., 2021).

Currently, the management of CPE focuses on haemodynamic stabilization, control of secondary infections and restoration of intestinal integrity (Mylonakis *et al*., 2016). Standard interventions include isotonic fluid resuscitation, treatment with broad-spectrum antimicrobials, anti-emetic therapy and nutritional support to maintain mucosal function (Ukwueze *et al*., 2022a). Early enteral nutrition has been reported to be essential, as it prevents villus atrophy, promotes epithelial regeneration and accelerates recovery time (Szefel *et al*., 2015; Mazzaferro, 2025). However, therapeutic approaches remain inconsistent among clinicians, reflecting the lack of standardized, evidence-based treatment protocols, particularly in resource-limited settings (Ukwueze *et al*., 2021).

Given the endemicity of CPE in Nigeria and the heterogeneity of therapeutic practices, there is an urgent need for standardized, evidence-based management framework adaptable to local resource constraints (Agada *et al*., 2022; Ukwueze *et al*., 2022b). Veterinary teaching hospitals play a pivotal role in shaping clinical competencies and guiding professional standards, yet systematic evaluations of their current treatment practices remain scarce

(Ogwuche *et al*., 2021; Ukwueze *et al*., 2022a). This study assessed the nutritional and microbiota management practices of Nigerian veterinary clinicians when CPE occur, to identify knowledge-practice gaps and provide an evidence base for the development of standardized, context-appropriate treatment protocols that will improve clinical outcomes.

Materials and Methods

Study design and Population: A descriptive cross-sectional survey was conducted between January 6 and March 28, 2025, across eight veterinary teaching hospitals (VTHs) and private veterinary clinics in Nigeria, involving 109 veterinary clinicians. The study evaluated current clinical practices in nutritional and microbiota management of canine parvoviral enteritis (CPE) among small-animal and mixed-animal practitioners, academics, researchers and specialists handling canine gastroenteritis cases. Study sites were purposively selected to represent Nigeria's six geopolitical zones: South-East (University of Nigeria, Nsukka; Michael Okpara University of Agriculture, Umudike), South-West (University of Ibadan; Federal University of Agriculture, Abeokuta), North-Central (University of Abuja; University of Ilorin; Joseph Sarwuan Tarka University, Makurdi), and North-West (Ahmadu Bello University, Zaria). These regions were chosen for their high density of canine ownership, clinical caseloads, and diverse urban-peri-urban settings representative of national veterinary practice (Hambolu *et al*., 2014; Ukwueze *et al*., 2022a; Mshelbwala *et al*., 2024)

Ethical Approval for the Study: Ethical clearance for the study was obtained from the Ministry of Agriculture and Rural Development (Approval No: VD 922/60). Informed consent was secured from all participants in accordance with the World Medical Association Declaration of Helsinki Ethical Principles (WMA, 2015) and the National Health Research Ethics Committee, Nigeria (NHREC, 2014).

Participant Selection and Sampling Criteria: Participants were licensed Nigerian veterinary clinicians actively engaged in the diagnosis and treatment of canine gastroenteritis, particularly that caused by canine parvovirus (CPV). Eligibility for the study was purposively selected based on the following criteria: (i). Professional qualifications: Doctor of Veterinary Medicine (DVM) or higher degree (MSc, PhD, Fellowship) or final-year veterinary students engaged in supervised clinical work. (ii). Practice engagement: actively practising in a clinical setting (small-animal practice, mixed practice, general practice, or academic/research hospitals). (iii). Case exposure: experience in management, diagnosis, and treatment of suspected or confirmed parvoviral enteritis or gastroenteritis cases within the last 12 months. (iv). Consent: voluntary agreement to participate and complete the structured questionnaire.

Survey instrument, Reliability assessment, and Questionnaire design: A structured questionnaire was administered via both Google form and in-person interviews. It included two sections: (i). Socio-demographics variables – institutional background, gender, age, years of experience, level of education. (ii). A detailed self-reported management practice for canine parvoviral enteritis (CPE), including nutritional management practices (early enteral vs. parenteral feeding, dietary planning and formulation, electrolyte balance maintenance, appetite stimulation, and use of gut-barrier supportive dietary components), and microbiota management practices (knowledge of microbiome changes, understanding of pathogenic vs. beneficial bacteria, probiotic use, and application of faecal microbiota transplantation [FMT]).

The questionnaire was reviewed by three independent experts (a small animal-medicine clinician, a public-health research scientist and an extension officer) to ensure construct validity, relevance, and domain coverage. A pilot test with five small animal clinicians (excluded from the main study) refined question clarity. Cronbach's alpha (α = 0.80) confirmed acceptable internal reliability primarily based on binary and Likert-type responses. This indicated a satisfactory level of internal reliability and was considered sufficient for exploratory public health research, particularly in field-based cross-sectional studies (Cho and Kim, 2015).

Data Analysis: Descriptive statistics (frequencies, percentages, central tendencies) was utilized to summarize socio-demographic-related data, using Microsoft Excel and the IBM SPSS® Version 26 software package. This descriptive methodology was adopted, as previously reported (Elelu *et al*., 2022). Items for Nutritional management practices and Microbiota management practices were scored on a 5-point ordinal scale (0 – 4), with higher scores indicating greater adherence to the recommended practice standards. The final practice instrument generated two composite scores. (i). Nutritional Management Score (NMS) - sum of five nutrition-related domains (range: 0 – 20): [NMS: Poor (0 – 4), Fair (5 – 8), Average (9 – 12), Good (13 – 16), Sound (17 – 20)]. (ii). Microbiota Management Score (MMS) - sum of four microbiota-related domains (range: 0 – 16): [MMS: Poor (0 – 3), Fair (4 – 6), Average (7 – 10), Good (11 – 13), Sound (14 – 16)]. Pearson's correlation coefficient (two-tailed) was applied to assess associations between demographic variables, NMS and MMS. Statistical significance was set at $p < 0.05$ for primary associations, with $p < 0.01$ considered highly significant.

Results

Socio-demography: A total of 109 veterinary clinicians participated in the survey, most aged 21 – 40 years (67.0%) and mainly males (79.8%) [Table 1a]. The majority of the participants were DVM degree holders (73.4%), with fewer holding postgraduate qualifications (Table 1a). Small-animal practice was the most common field of the respondents (53.2%), followed by general practice (26.6%) [Table 1a]. Most of the participants had 0 – 5 years of experience (58.7%), indicating a predominantly early-career group (Table 1a). The respondents were drawn from various institutions, majorly from Ahmadu Bello University (ABU) Zaria (22.9%) and the University of Ilorin Veterinary Teaching Hospitals (22.0%) [Table 1b].

Nutritional management: Adoption of core nutritional practices by the respondents was moderate, overall. Early enteral feeding majorly clustered at mid-scores (2 – 3) for 63.3% of clinicians, while 19.3% of the respondents achieved the top score. Electrolyte therapy was highly consistent (score was 2 in 73.4%), and appetite stimulation was widely practiced (score was 2 in 85.3%). In contrast, dietary planning showed variability (41.2% scored < 2), and gut-barrier supportive diets were inconsistently used (≤ 1 in 47.7% vs ≥ 3 in 44.9%). Total NMS ranged from 5 – 19, dominated by "Average" (60.6%) and "Fair" (23.9%) statuses, with fewer "Good" (14.7%) and "Sound" (0.9%) practitioners (Tables 2, 3 and 4).

Microbiota management: Conceptual understanding of microbiota management among the respondents was high, but clinical application was limited (Table 5). Knowledge of microbiome alterations scored 2 – 3 in 86.2%, and awareness of pathogenic vs. beneficial bacteria scored similarly in 83.5% (Table 5). However, probiotic use remained modest (29.4% none; 24.7% frequent use), and faecal microbiota transplantation (FMT) was least utilized (31.2% - none; 31.2% - regular use). Total MMS ranged from 0 – 16, peaking at 8 (19.3%), with most respondents classified as "Average" (45.9%), "Fair" (29.4%), or "Good" (13.8%) (Tables 5, 6 and 7).

Table 1a. Age, gender, qualifications, practice type and years of experience of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs.

Attributes	Categories	Frequency	Percentage
Age (years)	21 – 30	44	40.4%
	31 – 40	29	26.6%
	41 – 50	20	18.3%
	51 – 60	7	6.4%
	Undisclosed	9	8.3%
Gender	Male	87	79.8%
	Female	22	20.2%
Qualifications	DVM	80	73.4%
	Fellowship	5	4.6%
	MSc	8	7.3%
	PhD	15	13.8%
	Veterinary Students	1	0.9%
Practice type	Academics and Research	6	5.5%
	General practice	29	26.6%
	Large animal practice	2	1.8%
	Mixed practice	9	8.3%
	Small animal practice	58	53.2%
	Specialty practice	5	4.6%
Years of experience in veterinary practice	0 - 5 years	64	58.7%
	6 - 10 years	9	8.3%
	11 - 15 years	18	16.5%
	16 - 20 years	8	7.3%
	21 - 25 years	7	6.4%
	26 - 30 years	3	2.8%

Table 1b. Distribution of institutions of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs.

Institutions	Frequency	Percentage
Ahmadu Bello University VTH	25	22.9%
Federal University of Agriculture, Abeokuta VTH	7	6.4%
Joseph Sarwuan Tarka University, Makurdi VTH	8	7.3%
Ministry of Agriculture and Rural Development	1	0.9%
Michael Okpara University of Agriculture, Umudike VTH	8	7.3%
Private Practitioners	12	11.0%
University of Ibadan VTH	5	4.6%
University of Abuja VTH	4	3.7%
University of Jos VTH	1	0.9%
University of Ilorin VTH	24	22.0%
University of Nigeria, Nsukka VTH	14	12.8%

VTH – Veterinary Teaching Hospital

Table 2. Nutrition management strategy scores of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs.

Attributes	Scores	Frequency	Percentage
Early enteral vs. Parenteral nutrition scores	0	1	0.9%
	1	18	16.5%
	2	30	27.5%
	3	39	35.8%
	4	21	19.3%
Dietary scores	0	14	12.8%
	1	31	28.4%
	2	28	25.7%
	3	29	26.6%
	4	7	6.4%
Electrolyte balance scores	0	3	2.8%
	1	14	12.8%
	2	80	73.4%
	3	12	11.0%
	4	0	0%
Appetite stimulation scores	0	2	1.8%
	1	1	0.9%
	2	93	85.3%
	3	10	9.2%
	4	3	2.8%
Dietary components for strengthening gut barrier function scores	0	17	15.6%
	1	35	32.1%
	2	8	7.3%
	3	47	43.1%
	4	2	1.8%

Table 3. Distribution of total score on nutrition management strategy of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs.

Total score	Frequency	Percentage
5	3	2.8%
6	5	4.6%
7	8	7.3%
8	10	9.2%
9	17	15.6%
10	16	14.7%
11	15	13.8%
12	18	16.5%
13	5	4.6%
14	5	4.6%
15	4	3.7%
16	2	1.8%
19	1	0.9%

Table 4. Distribution of nutrition management status (NMS) scores of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs.

Status	Frequency	Percentage (%)
Poor NMS (0 - 4 of total score)	0	0%
Fair NMS (5 - 8 of total score)	26	23.9%
Average NMS (9 - 12 of total score)	66	60.6%
Good NMS (13 - 16 of total score)	16	14.7%
Sound NMS (17 - 20 of total score)	1	0.9%

Table 5. Microbiota management score of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs.

Attributes	Scores	Frequency	Percentage
Microbiome changes knowledge scores.	0	5	4.6%
	1	6	5.5%
	2	51	46.8%
	3	43	39.4%
	4	4	3.7%
Pathogenic vs. beneficial bacteria knowledge scores.	0	9	8.3%
	1	4	3.7%
	2	56	51.4%
	3	35	32.1%
	4	5	4.6%
Probiotic use scores.	0	32	29.4%
	1	30	27.5%
	2	20	18.3%
	3	25	22.9%
	4	2	1.8%
Faecal microbiota transplantation scores	0	34	31.2%
	1	14	12.8%
	2	27	24.8%
	3	30	27.5%
	4	4	3.7%

Table 6. Distribution of total score for microbiota management strategy of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs.

Total score	Frequency	Percentage
0	2	1.8%
1	2	1.8%
2	3	2.8%
3	3	2.8%
4	5	4.6%
5	10	9.2%
6	15	13.8%
7	10	9.2%
8	21	19.3%
9	10	9.2%
10	11	10.1%
11	8	7.3%
12	3	2.8%
13	4	3.7%
14	1	0.9%
16	1	0.9%

Table 7. Distribution of microbiota management status (MMS) scores of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs.

Status	Frequency	Percentage
Poor MMS (0 - 3 of total score)	10	9.2%
Fair MMS (4 - 6 of total score)	32	29.4%
Average MMS (7 - 10 of total score)	50	45.9%
Good MMS (11 - 13 of total score)	15	13.8%
Sound MMS (14 - 16 of total score)	2	1.8%

Pearson's Correlations: Pearson's correlation analysis results (Table 8) showed that the type of practice correlated negatively with both years of experience (r = -0.244, p = 0.011) and MMS (r = - 0.227, p = 0.018), indicating that small-animal practitioners, who formed the largest sub-group, were generally less experienced and had slightly lower microbiota management scores. Years of experience showed no significant association with either NMS or MMS (p > 0.05). However, NMS and MMS were positively correlated (r = 0.379, p < 0.001), suggesting that clinicians with better nutritional practices also demonstrated superior microbiota management (Table 8).

Discussion

This study provides one of the first systematic assessments of the nutritional and microbiota management practices of Nigerian veterinary clinicians, when canine parvoviral enteritis (CPE) occurs. Clinicians that participated in the study demonstrated moderate awareness of evidence-based principles such as nutritional stabilization, fluid therapy and microbiota modulation, indicating gradual integration of global standards into local practice. However, inconsistent use of probiotics, gut-barrier-supportive diets and faecal microbiota transplantation (FMT) highlights persistent implementation gaps. Most of the respondents were early-career veterinarians (0 – 5 years: 58.7%), primarily engaged in small-animal practice (53.2%), reflecting the demographic that most frequently manages CPE cases (Mazzaferro, 2025). The concentration of participants in key veterinary teaching hospitals underscores opportunities for structured mentorship, continuing education and standardized treatment frameworks to enhance CPE management capacity in Nigeria (Agnel *et al.*, 2025).

Table 8. Pearson correlation matrix of attributes of Nigerian veterinary clinicians (n = 109) who participated in the study to appraise their nutritional and microbiota management practices when parvoviral enteritis occur in dogs. [NMS - Nutrition management score; MMS - Microbiota management score]

		Type of practice	Years of experience	NMS status	MMS status
Type of practice	Pearson correlation (r)	1	-.244*	.021	-.227*
	Sig. (2-tailed)		.011	.826	.018
	N	109	109	109	109
Years of expertise	Pearson correlation (r)	-.244*	1	.091	-.022
	Sig. (2-tailed)	.011		.345	.817
	N	109	109	109	109
NMS status	Pearson correlation (r)	.021	.091	1	.379**
	Sig. (2-tailed)	.826	.345		.000
	N	109	109	109	109
MMS status	Pearson correlation (r)	-.227*	-.022	.379**	1
	Sig. (2-tailed)	.018	.817	.000	
	N	109	109	109	109

* Correlation is significant at p < 0.05 level (2-tailed); ** Correlation is significant at p < 0.01 level (2-tailed).

Nutritional management status (NMS) as recorded in this study was predominantly "Average" (60.6%), with moderate early enteral feeding uptake (63.3%) and consistent fluid and electrolyte correction (73.4%). These findings indicate reasonable awareness of the physiological importance of nutritional support in gastrointestinal recovery. Early enteral nutrition has been demonstrated to reduce intestinal permeability, preserve mucosal integrity and shorten hospital stay (Mazzaferro, 2025; Szefel *et al*., 2015, Mohr *et al*., 2003). However, 19.3% of clinicians achieved the highest score, suggesting that early feeding is not yet fully integrated into routine practice. This may be linked to historical recommendations to delay feeding in vomiting dogs (Carman and Povey, 1982) and the persisting uncertainty regarding its timing, as reflected in newer studies that recommend a cautious delay of 24 - 48 hours in severe cases (Zhou *et al*., 2025). Contemporary evidence, however, supports early enteral feeding within 12 – 24 hours of stabilization to prevent villus atrophy and enhance epithelial regeneration (Mazzaferro, 2025; Mohr *et al*., 2003; Candellone *et al*., 2020).

Electrolyte management practices were relatively good, reflecting high clinician familiarity with fluid therapy protocols. Electrolyte derangements, particularly hyponatraemia, hypochloraemia and hypokalaemia are well documented in CPE (Sykes, 2013; Tuteja *et al*., 2022). Their correction through isotonic crystalloid therapy, often lactated Ringer's solution supplemented with potassium chloride, remains the cornerstone of treatment (Mylonakis *et al*., 2016; Mazzaferro, 2025; Zhou *et al*., 2025). The predominance of "Average" scores (73.4% scoring 2) suggests that fluid therapy is routinely practiced and aligns with prior Nigerian studies reporting similar trends (Ukwueze *et al*., 2022a). The consistency across institutions implies that fluid therapy has been effectively integrated into both clinical and educational frameworks.

Dietary planning showed greater variability, with 41.2% of respondents scoring below 2, indicating limited adoption of individualized feeding strategies. Structured dietary planning is critical for optimizing energy intake, maintaining gut motility and reducing post-recovery complications (Candellone *et al*., 2020). The low uptake observed here likely reflects both resource limitations and inadequate clinician familiarity with therapeutic nutrition. Economic constraints, such as client inability to afford prescription diets, have been previously cited as barriers to optimal care (Hambolu *et al*., 2014; Shima *et al*., 2015; Mshelbwala *et al*., 2024). These same socioeconomic factors have hindered preventive measures like vaccination (Sykes, 2013; Hambolu *et al*., 2014) suggesting a broader systemic challenge that extends beyond clinician knowledge.

Appetite stimulation was widely practiced by respondents (85.3% scoring 2), which may reflect clinicians' efforts to hasten recovery; however, premature use can mask underlying nausea or systemic instability (Mohr *et al*., 2003; Mazzaferro, 2025). The inconsistent use of gut-barrier-supportive diets, reported by nearly half of respondents, reveals another key gap. Nutritional components such as glutamine, omega-3 fatty acids, and fermentable fibres are essential for intestinal repair and immune regulation (Rodrigues *et al*., 2017; Kim *et al*., 2023). The canine gut microbiome, dominated by Firmicutes, Bacteroidetes, and Fusobacteria, plays an integral role in mucosal metabolism and host immunity (Ritchie *et al*., 2008; Honneffer *et al*., 2017; Suchodolski, 2022). Diets that include these functional nutrients reportedly can promote short-chain fatty acid production and improve mucosal barrier function (Dahl *et al*., 2020; Koyama *et al*., 2024). Their inconsistent use, therefore, represents an opportunity for training and resource investment in clinical nutrition.

Microbiota management status (MMS) response by participants was "Average" for 45.9% of clinicians, with a similar trend to NMS, suggesting comparable proficiency levels. Knowledge of the gut microbiome's role in disease was high (≥ 80% scoring 2 – 3), consistent with global advances in understanding intestinal dysbiosis (Schmitz and Suchodolski, 2016; Suchodolski, 2022). However, practical application was limited. Only 24.7% of clinicians reported routine probiotic use, and 31.2% had attempted FMT. Limited access to commercial probiotics in Nigeria, coupled with scarce local research on their use in small-animal medicine (Kolawole *et al*., 2021) likely contributed to this gap. Nonetheless, the benefits of microbiota modulation are well documented. Arslan *et al*. (2012) observed improved survival (90%) and faster clinical recovery in probiotic-treated CPE dogs compared to controls (70%). Similarly, Park *et al*. (2019) and Molina *et al*. (2023) reported enhanced outcomes associated with microbiota restoration. FMT, while less common, has demonstrated efficacy in restoring microbial diversity and shortening hospital stays in parvoviral and other acute enteropathies (Mazzaferro, 2025; Honneffer *et al*., 2017; Pereira *et al*., 2018).

The observed positive correlation between NMS and MMS ($r = 0.379$, $p < 0.001$) indicates that clinicians proficient in nutritional management also tend to perform better in microbiota management. This inter-relationship supports the concept of an integrated treatment approach, where early enteral nutrition and microbiota restoration act synergistically to enhance mucosal recovery (Honneffer *et al*., 2017; Dahl *et al*., 2020). Conversely, the negative correlation between years of experience and MMS suggests that younger clinicians, though theoretically informed, may lack practical experience and access to resources. Addressing these disparities through structured CME programs, clinical mentorship, and research dissemination could strengthen national treatment capacity.

Limitations of the study: This study has certain limitations that should be acknowledged. Participants were largely clinicians working in Nigerian veterinary teaching hospitals, which, although appropriate for assessing institutional clinical practices, may not fully represent private or rural veterinary settings. As a cross-sectional survey, the study relied on self-reported practices that could be influenced by recall or social desirability bias. Additionally, the design did not include longitudinal follow-up, limiting the assessment of long-term treatment outcomes or sustained effects of nutritional and microbiota interventions (Mylonakis *et al*., 2016; Tuthill, 2020). Nevertheless, the focus on teaching hospitals provides a valuable insight into the current standard of care in academic veterinary medicine and establishes a benchmark for developing standardized, evidence-based CPE management protocols in Nigeria.

Conclusions: This study highlights both progress and persistent gaps in the clinical management of canine parvoviral enteritis (CPE) in Nigeria. While veterinary clinicians demonstrated a solid theoretical understanding of CPE pathophysiology and consistent application of fluid therapy and supportive care in line with international standards (Mylonakis *et al*., 2016; Tuteja *et al*., 2022; Mazzaferro, 2020), notable variability persists in nutritional planning, early enteral feeding and microbiota modulation (Mohr *et al*., 2003; Candellone et al., 2020; Schmitz and Suchodolski, 2016). These inconsistencies underscore a broader knowledge-practice gap, particularly among early-career veterinarians in small-animal practice, the group most frequently managing CPE cases (Agnel *et al*., 2025). Limited integration of evidence-based nutritional and microbiota interventions likely contributes to delayed recovery, increased morbidity, and greater financial strain on pet owners (Ukwueze *et al*., 2022a; Kim *et al*., 2023).

To address these gaps, this study proposes a standardized, resource-sensitive framework for CPE management, specifically tailored for adoption in the Nigerian context and adaptable across varying levels of resource availability (see Appendix: Supplementary Material). By embedding evidence-based nutritional and microbiota practices into continuing medical education (CME), mentorship structures and institutional standard operating procedures (SOPs), the proposed framework supports scalable improvements in treatment outcomes and clinical efficiency (Candellone *et al*., 2020; Unterer and Busch, 2021; Mazzaferro, 2025). Implementing this structured approach has the potential to enhance survival rates, strengthen veterinary education and advance animal welfare across sub-Saharan Africa and other low- and middle-income settings (Hambolu *et al*., 2014; Mshelbwala *et al*., 2024).

Recommendations: The positive association between nutritional management status (NMS) and microbiota management status (MMS) in the present study highlights the importance of integrated therapeutic approaches that combine nutritional stabilization with microbiota restoration (Honneffer *et al*., 2017; Dahl *et al*., 2020). To translate these findings into practice, structured, resource-sensitive interventions are recommended for Nigerian clinicians and comparable LMIC settings (Ukwueze *et al*., 2022a; Mshelbwala *et al*., 2024).

Targeted training modules should be incorporated into veterinary curricula and continuing medical education (CME) programs, emphasizing early enteral nutrition, individualized dietary planning, and microbiota modulation through probiotics or faecal microbiota transplantation (FMT). Practical case-based training in veterinary teaching hospitals would strengthen clinician confidence and standardize implementation (Agnel *et al*., 2025; Mohr *et al*., 2003; Sykes, 2013).

Veterinary teaching hospitals and regulatory bodies should adopt a tiered, context-appropriate protocol for CPE management that aligns with available resources (Agada *et al*., 2022; Ukwueze *et al*., 2022b). This framework should specify essential interventions at primary (stabilization and basic nutrition), secondary (integrated dietary and microbiota support) and tertiary (advanced critical care, FMT) levels (Mazzaferro, 2020; 2025).

A 10-point clinician checklist covering isolation, hydration, electrolyte balance, early feeding, gut support, and microbiota restoration (see Appendix: Supplementary Material), should be embedded into daily ward rounds. Regular audits and run-chart tracking can help shift average performance toward “Good” or “Sound” practice categories (Agnel *et al*., 2025).

Future studies should evaluate the cost-effectiveness and outcomes of microbiota-directed interventions such as probiotics and FMT in Nigerian contexts (Arslan *et al*., 2012; Pereira *et al*., 2018; Molina *et al*., 2023). Local production of veterinary probiotics using indigenous bacterial strains could reduce dependency on imported products and improve clinical accessibility (Suchodolski, 2022; Kolawole *et al*., 2021).

National veterinary associations and ministries of agriculture should prioritize nutritional and microbiota management within animal health policies, fostering collaboration between clinicians, nutritionists and microbiome researchers to strengthen veterinary infectious disease control frameworks (Ogwuche *et al*., 2021; Hambolu *et al*., 2014).

Conflict of interest

The authors have no conflict of interest to declare. The authors further declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Acknowledgement

The authors would like to acknowledge members of the International Veterinary Student Association (IVSA) Nigeria, specifically Dr. Aishat A. Lawal (IVSA FUNAAB) and Dr. Maureen O. Obianuju (IVSA JOSTUM), as well as the entire membership of IVSA MOAUA, for their assistance in distributing questionnaires to various clinicians at their respective veterinary schools.

References

Agada IOC-I, Ameh JA, Olabode OH and Echioda-Ogbole M (2022). Occurrence and distribution patterns of canine parvoviral enteritis in Abuja Nigeria. *Journal of Virological Sciences*, 10(2): 1 – 7.

Agnel J, Molle J, Colson S and Chays-Amania A (2025). The impact of the evidence-based practice mentor on nurses: a scoping review. *Worldviews on Evidence-Based Nursing*, 22(2): 70016.

Arslan H, Aksu D, Terzi Gülel G and Nisbet C (2012). Therapeutic effects of probiotic bacteria in parvoviral enteritis in dogs. *Revue de Medecine Veterinaire*, 163: 55 – 59.

Candellone A, Cerquetella M, Girolami F, Badino P and Odore R (2020). Acute diarrhea in dogs: current management and potential role of dietary polyphenols supplementation. *Antioxidants*, 9(8): 725.

Carman S and Povey C (1982). Successful experimental challenge of dogs with canine parvovirus-2. *Canadian Journal of Comparative Medicine*, 46(1): 33.

Cho E and Kim S (2015). Cronbach's coefficient alpha: well known but poorly understood. *Organizational Research Methods*, 18(2): 207 – 230.

Dahl WJ, Rivero Mendoza D and Lambert JM (2020). Diet nutrients and the microbiome. *Progress in Molecular Biology and Translational Science*, 171: 237 – 263.

Decaro N, Buonavoglia C and Barrs VR (2020). Canine parvovirus vaccination and immunisation failures: are we far from disease eradication? *Veterinary Microbiology*, 247: 108760.

Elelu N, Agene G, Sanusi F and Al-Mustapha AI (2022). A cross-sectional questionnaire survey on knowledge of anti-protozoal drug use and resistance among animal health professionals in Kwara State Nigeria. *BMC Veterinary Research*, 18: 214.

Ford J, McEndaffer L, Renshaw R, Molesan A and Kelly K (2017). Parvovirus infection is associated with myocarditis and myocardial fibrosis in young dogs. *Veterinary Pathology*, 54(6): 964 – 971.

Hambolu SE, Dzikwi AA, Kwaga JKP, Kazeem HM, Umoh JU and Hambolu DA (2014). Dog ecology and population studies in Lagos State Nigeria. *Global Journal of Health Science*, 6(2): 209.

Honneffer JB, Steiner JM, Lidbury JA and Suchodolski JS (2017). Variation of the microbiota and metabolome along the canine gastrointestinal tract. *Metabolomics*, 13(3): 1 – 20.

Inbaraj C, Thangapandiyan M and Kumaravel P (2023). Comparative study on medical management of parvo viral enteritis in dogs. *Journal of Krishi Vigyan*, 11(Suppl): 251 – 254.

Kim SS, Lee D, Chae Y, Koo Y, Yun T, Kang BT et al (2023). Adjuvant treatment with L-alanyl-L-glutamine supplementation in dogs with parvoviral enteritis. *Journal of Biomedical and Translational Research*, 24(2): 11 – 21.

Kolawole BJ, Nwoha RIO, Erin JP and Orakpoghenor O (2021). Changes in serum biochemical parameters of experimental *Trypanosoma brucei brucei*-infected Nigerian indigenous dogs administered multispecies probiotic and diminazene aceturate. *Journal of Parasitic Diseases*, 45(4): 1071.

Koyama K, Akiyama R, Oda H, Komiya T, Gokita K, Sako T et al (2024). Effect of commercial prescription diets containing prebiotics on clinical signs and fecal microbiome in dogs with intestinal disease. *Polish Journal of Veterinary Sciences*, 27(4): 599 – 610.

Mazzaferro EM (2020). Update on canine parvoviral enteritis. *Veterinary Clinics of North America: Small Animal Practice*, 50(6): 1307 – 1325.

Mazzaferro EM (2025). Update on canine parvoviral enteritis. *Veterinary Clinics of North America: Small Animal Practice*, 55(3): 405 – 425.

Mohr AJ, Leisewitz AL, Jacobson LS, Steiner JM, Ruaux CG and Williams DA (2003). Effect of early enteral nutrition on intestinal permeability intestinal protein loss and outcome in dogs with severe parvoviral enteritis. *Journal of Veterinary Internal Medicine*, 17(6): 791 – 798.

Molina RA, Villar MDU, Miranda MH, Maldonado NC, Vignolo GM and Nader-Macias MEF (2023). A multi-strain probiotic promoted recovery of puppies from gastroenteritis in a randomized double-blind placebo-controlled study. *The Canadian Veterinary Journal*, 64(7): 666.

Mshelbwala PP, Rupprecht CE, Osinubi MO, Njoga EO, Orum TG, Weese JS et al (2024). Factors influencing canine rabies vaccination among dog-owning households in Nigeria. *One Health*, 18: 100751.

Mylonakis ME, Kalli I and Rallis TS (2016). Canine parvoviral enteritis: an update on the clinical diagnosis, treatment and prevention. *Veterinary Medicine: Research and Reports*, 7: 91.

Nandi S and Kumar M (2010). Canine parvovirus: current perspective. *Indian Journal of Virology*, 21(1): 31.

NHREC (National Health Research Ethics Committee) (2014). National Code of Health Research Ethics. National Health Research Ethics Committee of Nigeria, Abuja, Nigeria.

Ogbu KI, Chukwudi IC, Mira F, Eze UU, Bella S, Olaolu OS et al (2021). Current status and risk factors of canine parvovirus type 2 in North Central Nigeria. *Comparative Immunology Microbiology and Infectious Diseases*, 74: 101578.

Ogwuche A, Ekiri AB, Endacott I, Maikai BV, Idoga ES, Alafiatayo R et al (2021). Antibiotic use practices of veterinarians and para-veterinarians and the implications for antibiotic stewardship in Nigeria. *Journal of the South African Veterinary Association*, 92: 1 – 14.

Park JS, Guevarra RB, Kim BR, Lee JH, Lee SH, Cho JH et al (2019). Intestinal microbial dysbiosis in beagles naturally infected with canine parvovirus. *Journal of Microbiology and Biotechnology*, 29(9): 1391 – 1400.

Pereira GQ, Gomes LA, Santos IS, Alfieri AF, Weese JS and Costa MC (2018). Fecal microbiota transplantation in puppies with canine parvovirus infection. *Journal of Veterinary Internal Medicine*, 32(2): 707 – 711.

Ritchie LE, Steiner JM and Suchodolski JS (2008). Assessment of microbial diversity along the feline intestinal tract using 16S rRNA gene analysis. *FEMS Microbiology Ecology*, 66(3): 590 – 598.

Rodrigues AKS, Silva GB, Almeida TLAC, Borba NM, Cordeiro Manso HECC and Manso Filho HC (2017). Effects of glutamine and glutamate supplementation in dogs with hemorrhagic enteritis. *Comparative Clinical Pathology*, 26(2): 315 – 320.

Sato-Takada K, Flemming AM, Voordouw MJ and Carr AP (2022). Parvovirus enteritis and other risk factors associated with persistent gastrointestinal signs in dogs later in life: a retrospective cohort study. *BMC Veterinary Research*, 18(1): 1 – 14.

Schmitz S and Suchodolski J (2016). Understanding the canine intestinal microbiota and its modification by pro pre and synbiotics: what is the evidence? *Veterinary Medicine and Science*, 2(2): 71.

Shima FK, Apaa TT and Mosugu JIT (2015). Epidemiology of canine parvovirus enteritis among hospitalized dogs in Effurun/Warri metropolitan region of Delta State Nigeria. *Open Access Library Journal*, 2(1): 1 – 7.

Suchodolski JS (2022). Analysis of the gut microbiome in dogs and cats. *Veterinary Clinical Pathology*, 50(S1): 6 – 17.

Sykes JE (2013). Canine parvovirus infections and other viral enteritides. *Canine and Feline Infectious Diseases*, 141.

Szefel J, Kruszewski WJ and Buczek T (2015). Enteral feeding and its impact on the gut immune system and intestinal mucosal barrier. *Przeglad Gastroenterologiczny*, 10(2): 71 – 77.

Tuteja D, Banu K and Mondal B (2022). Canine parvovirology: a brief updated review on structural biology occurrence pathogenesis clinical diagnosis treatment and prevention. *Comparative Immunology Microbiology and Infectious Diseases*, 82: 101765.

Tuthill EL, Maltby AE, DiClemente K and Pellowski JA (2020). Longitudinal qualitative methods in health behavior and nursing research: assumptions, design, analysis and lessons learned. International Journal of Qualitative Methods, 19: 1609406920965799.

Ukwueze CS, Anene BM, Nwosuh CI and Ezeokonkwo RC (2021). Current trends of canine parvoviral enteritis: Nigeria perspective. *Bangladesh Journal of Veterinary Medicine*, 19(2): 131 – 138.

Ukwueze CS, Ememe MU, Ibe CS, Unigwe RC, Kalu SU, Udeani IJ and Udegbunam SO (2022b). Retrospective study of canine parvoviral enteritis in veterinary teaching hospitals in South East Nigeria. *Animal Research International*, 19(2): 4515 – 4522.

Ukwueze CS, Kalu E, Ememe MU and Unigwe RC (2022a). Assessment of clinical management of canine parvoviral enteritis in South East Nigeria. *Journal of Sustainable Veterinary and Allied Sciences*, 2(2): 62.

Unterer S and Busch K (2021). Acute hemorrhagic diarrhea syndrome in dogs. *Veterinary Clinics of North America: Small Animal Practice*, 51(1): 79 – 92.

WMA (World Medical Association) (2015). Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects (2015 Amendment). World Medical Association, Ferney-Voltaire, France.

Zhou X, Wu Y and Zhu Z (2025). Mucosal immune response in biology disease prevention and treatment. *Signal Transduction and Targeted Therapy*, 10: 7.

Appendix: Supplementary Material

Standardized, Resource-Tiered Treatment Pathway for Canine Parvoviral Enteritis (CPE)

This appendix provides a structured, context-sensitive protocol for managing CPE in low- and middle-income veterinary settings such as Nigeria. It is based on consolidated clinical evidence and expert consensus (Mylonakis *et al.*, 2016; Candellone *et al.*, 2020; Mazzaferro, 2020; Tuteja *et al.*, 2022; Mazzaferro, 2025). The pathway integrates essential stabilization, nutritional and microbiota-management principles to guide clinicians at primary, secondary and tertiary levels of care.

1. Triage and Isolation

- Immediate isolation: Designate a parvovirus ward or confined area; enforce barrier nursing (PPE, disinfectant footbaths, chlorine-based solutions).
- Initial assessment: Mentation, hydration, capillary refill time (CRT), temperature, vomiting and diarrhea frequency, haematochezia.
- Point-of-care diagnostics: Packed cell volume (PCV), total solids (TS), blood glucose, lactate, and CPV antigen rapid test, where feasible (Ulas *et al.*, 2024).

2. Fluid, Electrolyte and Glucose Stabilization

- Shock therapy: Balanced crystalloids (Ringer's lactate, Plasma-Lyte, 0.9 % NaCl) 20 – 30 mL/kg IV bolus over 15 – 20 minutes; repeat up to 80 – 90 mL/kg as needed.
- Maintenance: 2 – 4 mL/kg/h after stabilization, adjusting for losses.
- Electrolytes: Add KCl to maintain 3.5 – 4.5 mEq/L (≤ 0.5 mEq/kg/h IV).
- Glucose: If blood glucose (BG) < 70 mg/dL, 0.5 g/kg bolus then 2.5 – 5 % dextrose infusion.
- Colloids (if available): 5 mL/kg hetastarch or Voluven for hypoproteinemia or refractory shock (Tuteja *et al.*, 2022; Mazzaferro, 2025).

3. Antiemetic and Gastrointestinal Support

- Primary antiemetic: Maropitant 1 mg/kg SC q24h.
- Adjuncts: Ondansetron 0.1–0.2 mg/kg IV q8–12h or Metoclopramide CRI 1–2 mg/kg/day.
- Gastroprotection: Omeprazole 0.7–1 mg/kg PO/IV q12–24h for GI bleeding; avoid routine acid suppression (Marks *et al.*, 2018).

4. Analgesia

- Visceral pain control: Buprenorphine 0.01–0.02 mg/kg IV/IM q6–8h.
- Avoid NSAIDs in hypovolemia, dehydration, or renal compromise (Hellyer *et al.*, 2007).

5. Antimicrobial Therapy

- Indications: Neutropenia, fever, hematochezia, or systemic illness.
- First-line: Ampicillin 22–30 mg/kg IV q8h or Cefazolin 22 mg/kg IV q8h.
- Add Gram-negative coverage: Enrofloxacin 10 mg/kg q24h or Ceftriaxone 20–30 mg/kg IV q24h.
- Add anaerobic coverage: Metronidazole 10–15 mg/kg q12h (IV/PO) (ISCAID Guidelines – Lappin *et al.*, 2017).

6. Anti-parasitic treatment/Deworming

- Fenbendazole: 50 mg/kg PO q24h for 3–5 days to control concurrent parasitism (Otranto *et al.*, 2021).

7. Early Enteral Nutrition (12 – 24 hours post-stabilization)

- Resting energy requirement (RER): 70 × (BW ^ 0.75) or 30 × BW + 70 (for 2 – 45 kg dogs).
- Feeding plan: Start at 25–33 % RER in 6 – 8 small meals or via NE/NG tube; reach full RER within 48 – 72 hours.
- Diet: Highly digestible, moderate fat, adequate protein; hydrolyzed formula

preferred (Mohr *et al.*, 2003; Tenne *et al.*, 2016; Mazzaferro, 2025).

8. Gut-Barrier and Micronutrient Support

- Key nutrients: Glutamine and zinc for enterocyte recovery (Rodrigues *et al.*, 2017; Kim *et al.*, 2023).
- Omega-3 (EPA/DHA): Begin once oral feeding is tolerated.
- Soluble fibre: Psyllium or inulin to stimulate short-chain fatty acid production (Dahl *et al.*, 2020).

9. Microbiota Management

- Probiotics: Start after vomiting control and feeding initiation; continue 7 – 14 days.
- Prefer veterinary-grade strains (e.g., *Enterococcus faecium* NCIMB 10415, Lactobacillus/Bifidobacterium mixes) (Schmitz and Suchodolski, 2016).
- Faecal microbiota transplantation (FMT): Consider for refractory diarrhea or severe dysbiosis in referral centres with donor-screening SOPs (Pereira *et al.*, 2018; Mazzaferro, 2025).

10. Monitoring and Follow-Up

- Daily parameters: Hydration, perfusion, body weight, vomiting/diarrhea logs, BG, electrolytes, PCV/TS.
- Red-flag indicators: Persistent shock, uncontrolled vomiting, hypoglycemia, melena, severe neutropenia → intensify care or refer.
- Discharge instructions: Continue anti-emetics and probiotics; gradual diet transition (5 – 7 days); strict home quarantine ≥ 2 weeks; disinfection and revaccination for in-contact dogs (Hambolu *et al.*, 2014; Mshelbwala *et al.*, 2024).

11. Infection Prevention and Control

- Dedicated equipment and PPE; routine chlorine disinfection; safe waste handling (WSAVA IPC Guidelines – Monteiro *et al.*, 2022).

12. Audit and Quality Improvement Checklist

A 10-item CPE Care Checklist enables shift-by-shift evaluation of compliance with the pathway. Performance should be tracked monthly using run charts to document improvement (Agnel *et al.*, 2025).

Domain	Checklist Item	Completed (☐)
Isolation & IPC	Dedicated area, PPE, bleach solution ready	☐
Fluids	Bolus given, reassessment documented	☐
Electrolytes	K^+ plan documented; dextrose if hypoglycemic	☐
Anti-emetic	Maropitant/ondansetron initiated	☐
Analgesia	Pain control documented	☐
Antibiotics	Indication checked; regimen recorded	☐
Nutrition	Enteral feeding within 24 hours of stabilization	☐
Gut Support	Digestible diet; micronutrients recorded	☐
Probiotics	Initiated once feeding tolerated	☐
Monitoring	Vitals and lab parameters tracked	☐

Implementation Note

This standardized protocol was designed to be resource-adaptive:

a. Primary care: Focus on stabilization, electrolyte correction, early feeding.
b. Secondary care: Add structured diet formulation and probiotics.
c. Tertiary/referral care: Incorporate FMT and advanced monitoring.

When applied systematically, these steps are expected to reduce case fatality rates and hospital stay durations, improving both clinical and educational outcomes (Mazzaferro, 2025; Unterer and Busch, 2021).

References for Appendix (Supplementary Material): Standardized, Resource-Tiered Treatment Pathway for Canine Parvoviral Enteritis (CPE)

Agnel J, Molle J, Colson S and Chays-Amania A (2025). The impact of the evidence-based practice mentor on nurses: a scoping review. *Worldviews on Evidence-Based Nursing*, 22(2): 70016.

Candellone A, Cerquetella M, Girolami F, Badino P and Odore R (2020). Acute diarrhea in dogs: current management and potential role of dietary polyphenols supplementation. *Antioxidants*, 9(8): 725.

Dahl WJ, Rivero Mendoza D and Lambert JM (2020). Diet nutrients and the microbiome. *Progress in Molecular Biology and Translational Science*, 171: 237 – 263.

Hambolu SE, Dzikwi AA, Kwaga JKP, Kazeem HM, Umoh JU and Hambolu DA (2014). Dog ecology and population studies in Lagos State Nigeria. *Global Journal of Health Science*, 6(2): 209.

Hellyer P, Rodan I, Brunt J, Downing R, Hagedorn JE, Robertson SA et al (2007). AAHA/AAFP pain management guidelines for dogs and cats. *Journal of Feline Medicine and Surgery*, 9(6): 466 – 480.

Kim SS, Lee D, Chae Y, Koo Y, Yun T, Kang BT et al (2023). Adjuvant treatment with L-alanyl-L-glutamine supplementation in dogs with parvoviral enteritis. *Journal of Biomedical and Translational Research*, 24(2): 11 – 21.

Lappin MR, Blondeau J, Boothe D, Breitschwerdt EB, Guardabassi L, Lloyd DH et al (2017). Antimicrobial use guidelines for treatment of respiratory tract disease in dogs and cats: antimicrobial guidelines working group of the International Society for Companion Animal Infectious Diseases. *Journal of Veterinary Internal Medicine*, 31(2): 279 – 294.

Marks SL, Whitehead Z, Annandale CH, Schoeman JP and Botha WJ (2018). Prevalence of Salmonella in juvenile dogs affected with parvoviral enteritis. *Journal of the South African Veterinary Association*, 89(1): 1 – 6.

Mazzaferro EM (2020). Update on canine parvoviral enteritis. *Veterinary Clinics of North America: Small Animal Practice*, 50(6): 1307 – 1325.

Mazzaferro EM (2025). Update on canine parvoviral enteritis. *Veterinary Clinics of North America: Small Animal Practice*, 55(3): 405 – 425.

Mohr AJ, Leisewitz AL, Jacobson LS, Steiner JM, Ruaux CG and Williams DA (2003). Effect of early enteral nutrition on intestinal permeability intestinal protein loss and outcome in dogs with severe parvoviral enteritis. *Journal of Veterinary Internal Medicine*, 17(6): 791 – 798.

Monteiro BP, Lascelles BDX, Murrell J, Robertson S, Steagall PVM, Wright B et al (2022). 2022 WSAVA guidelines for the recognition, assessment and treatment of pain. *Journal of Small Animal Practice*, 64(4): 177 – 254.

Mshelbwala PP, Rupprecht CE, Osinubi MO, Njoga EO, Orum TG, Weese JS et al (2024). Factors influencing canine rabies vaccination among dog-owning households in Nigeria. *One Health*, 18: 100751.

Mylonakis ME, Kalli I and Rallis TS (2016). Canine parvoviral enteritis: an update on the clinical diagnosis, treatment and prevention. *Veterinary Medicine: Research and Reports*, 7: 91.

Otranto D, Strube C and Xiao L (2021). Zoonotic parasites: the One Health challenge. *Parasitology Research*, 120(12): 4073 – 4074.

Pereira GQ, Gomes LA, Santos IS, Alfieri AF, Weese JS and Costa MC (2018). Fecal microbiota transplantation in puppies with canine parvovirus infection. *Journal of Veterinary Internal Medicine*, 32(2): 707 – 711.

Rodrigues AKS, Silva GB, Almeida TLAC, Borba NM, Cordeiro Manso HECC and Manso Filho HC (2017). Effects of glutamine and glutamate supplementation in dogs with hemorrhagic enteritis. *Comparative Clinical Pathology*, 26(2): 315 – 320.

Schmitz S and Suchodolski J (2016). Understanding the canine intestinal microbiota and its modification by pro pre and synbiotics: what is the evidence? *Veterinary Medicine and Science*, 2(2): 71.

Tenne R, Sullivan LA, Contreras ET, Olea-Popelka F, Twedt DC, Fankhauser J et al (2016). Palatability and clinical effects of an oral recuperation fluid during the recovery of dogs with suspected parvoviral enteritis. *Topics in Companion Animal Medicine*, 31(2): 68 – 72.

Tuteja D, Banu K and Mondal B (2022). Canine parvovirology: a brief updated review on structural biology occurrence pathogenesis clinical diagnosis treatment and prevention. *Comparative Immunology Microbiology and Infectious Diseases*, 82: 101765.

Ulas N, Ozkanlar Y, Ozkanlar S, Timurkan MO and Aydin H (2023). Clinical and inflammatory response to antiviral treatments in dogs with parvoviral enteritis. *Journal of Veterinary Science*, 25(1): e11.

Unterer S and Busch K (2021). Acute hemorrhagic diarrhea syndrome in dogs. *Veterinary Clinics of North America: Small Animal Practice*, 51(1): 79 – 92.