

ANEMIA IN DOGS: DISEASE CLASSIFICATIONS, SEVERITY, AND CONCURRENT DISEASES IN NORTHEAST THAILAND

Narichsara Lertchaisathaporn¹, Pattara-Anong Bupata¹, Natruethai Thititanasub¹,
Panisara Kunkitti² and Pucharatsm Pannin^{3,*}

¹ Veterinary Teaching Hospital, Faculty of Veterinary Medicine, Khon Kaen University

² Department of Veterinary Structural and Clinical Interventional Sciences, Khon Kaen University

³ Department of Anatomy, Faculty of Medicine, Khon Kaen University

Received: 9 August 2026

Revised: 30 August 2026

Accepted: 31 August 2026

Abstract

Anemia is a common hematologic abnormality in dogs and may occur in association with various underlying diseases. However, previous studies have described causes of anemia or focused on specific diseases, while information on diseases associated with anemia in dogs remains limited. This retrospective study investigated disease classifications, anemia severity, primary diagnoses, and concurrent diseases in anemic dogs presented to a veterinary teaching hospital in Northeast Thailand. Medical records and hematologic results from January to December 2024 were retrospectively reviewed. Dogs with a PCV <37% were considered anemic, and dogs younger than six months of age or with acute blood loss were excluded. Of 4,682 dogs identified, 1,013 (21.6%) were included in the study. Neoplasia was the most common disease classification (24.9%), with mild anemia predominating, followed by vector-borne infectious diseases (20.2%) and CKD (16.6%), in which mild anemia also predominated. Moderate anemia predominated in vector-borne infectious, systemic bacterial infectious, and immune-mediated diseases. Bone marrow disorders had the

* Corresponding author: Pucharatsm Pannin

E-mail: ppucharatsm@gmail.com

highest proportions of severe and very severe anemia, and anemia severity differed significantly among disease classifications ($p < 0.0001$). CKD was the most common primary diagnosis (15.8%), followed by ehrlichiosis (9.3%), and concurrent diseases were frequently identified. Overall, the findings demonstrate that anemia severity varies among disease classifications and that concurrent diseases are common in anemic dogs.

Keywords: Disease classifications, Anemia severity, Concurrent diseases

Introduction

Anemia is one of the most frequently identified hematologic abnormalities in canine patients and may occur as a consequence of various underlying diseases (Borin-Crivellenti et al., 2023; Stokol, 2024). Reduced red blood cell mass decreases tissue oxygen delivery and can cause lethargy, weakness, and exercise intolerance (Grimes & Fry, 2015). In clinical practice, identification of anemia provides an opportunity to investigate the underlying causes of anemia, including both primary diseases and concurrent conditions (Liu & Su, 2015). Therefore, evaluation of anemia severity and concurrent diseases associated with hematologic changes may provide information for diagnosis and clinical management (Lippi et al., 2021).

Pathogenesis of anemia occurs through three mechanisms, including decreased erythrocyte production, increased erythrocyte destruction, and blood loss (Stokol, 2024). The mechanism of anemia varies according to the underlying disease and may influence both anemia severity and associated hematologic abnormalities (Chikazawa & Dunning, 2016). Therefore, evaluating anemia severity and hematologic characteristics across different disease classifications may improve understanding of disease-associated hematologic patterns and provide clinically relevant information for diagnostic evaluation and case management (Lippi et al., 2021; Thongsahuan et al., 2020).

Although previous studies have investigated anemia associated with specific diseases, including chronic inflammatory disease, immune-mediated hemolytic anemia, vector-borne disease, chronic kidney disease, and neoplasia, most investigations have focused on individual disease entities rather than evaluating the distribution and severity of anemia across diverse underlying diseases (Parachini-Winter et al., 2019; Grimes & Fry, 2015; Little, 2010). Furthermore, although previous studies have described the causes of anemia or focused on specific diseases, a comprehensive understanding of diseases associated with anemia in dogs remains limited. These findings may provide useful baseline information for future clinical and epidemiological studies. Therefore, the objective of this retrospective study was to investigate disease classifications, anemia severity, primary diagnoses, and concurrent diseases in anemic dogs presented to a veterinary teaching hospital in Northeast Thailand.

Materials and Methods

1. Inclusion criteria and study population: A retrospective observational study was conducted using medical records and the laboratory database of dogs presented to the Veterinary Teaching Hospital, Khon Kaen University, Khon Kaen, Thailand, between January and December 2024. The database was searched to identify dogs with anemia based on packed cell volume (PCV) values below 37%.

Dogs were included if they fulfilled the following criteria: (1) PCV <37%, indicating anemia; and (2) sufficient clinical information was available to determine the primary diagnosis and classify cases into disease classifications. Dogs younger than six months of age, dogs with acute blood loss, incomplete medical records, an unavailable primary diagnosis, or insufficient clinical information were excluded from the study. Dogs with acute blood loss were excluded because the present study evaluated anemia associated with underlying diseases, whereas acute blood loss represents a different etiology

of anemia (Paltrinieri, 2014). For dogs with multiple disease conditions, the primary diagnosis was assigned by the researchers based on the condition considered most clinically important and most relevant to the principal clinical presentation and to anemia, as determined from medical records, laboratory findings, and underlying pathophysiological mechanisms. Predefined decision rules and priority criteria were used to determine the primary diagnosis when multiple disease conditions were present. Other coexisting conditions were recorded separately as concurrent diseases.

2. Diagnostic criteria for major diseases: Major disease diagnoses were determined based on clinical diagnoses documented in the medical records and supported by available laboratory and diagnostic findings. For dogs with multiple conditions, predefined decision rules and priority criteria were used to assign the primary disease classification. CKD was assigned the highest priority based on IRIS staging using serum creatinine and/or SDMA, with substaging by proteinuria and blood pressure (Elliott & White, 2023). IMHA, including suspected IMHA, and blood-smear-confirmed *Ehrlichia canis* infection were prioritized over CKD, with IMHA prioritized when both were identified (Garden et al., 2019; Neer et al., 2002). Blood-smear-confirmed or serology-positive *E. canis* infection was classified as vector-borne infectious disease when no other primary disease was identified. Pancreatitis was classified as inflammatory when occurring alone or with SIRS, or as associated with systemic disease when accompanied by sepsis or DKA (Behrend et al., 2018; Fabrès et al., 2019). Cases with pancytopenia, bone marrow suppression, or primary bone marrow disease were classified as bone marrow disorders (Girardi et al., 2017).

3. Data collection: Clinical information was retrospectively obtained from medical records and the laboratory database. Recorded variables included primary diagnoses, concurrent diseases, disease classifications, and anemia severity. The PCV value obtained during the initial diagnostic evaluation was used to classify anemia severity.

4. Classification of underlying diseases: Dogs were retrospectively assigned to disease classification groups according to the underlying pathophysiologic process associated with the clinical diagnosis. The following nine disease classifications were used: vector-borne infectious diseases, neoplasia, systemic bacterial infectious diseases, chronic kidney disease, immune-mediated diseases, inflammatory diseases, bone marrow disorders, endocrine and metabolic diseases, and other diagnoses. Vector-borne infectious diseases included ehrlichiosis (*Ehrlichia* spp.), anaplasmosis (*Anaplasma* spp.), babesiosis (*Babesia* spp.), trypanosomiasis (*Trypanosoma* spp.), and microfilaremia. Neoplasms were further classified by tumor type when specified; cases without a specified tumor type were classified as unspecified neoplasia. Systemic bacterial infectious diseases included sepsis, leptospirosis, pyometra, septic metritis, septic peritonitis, bacterial pneumonia, and melioidosis. Inflammatory diseases included pancreatitis, chronic inflammatory enteropathy, pythiosis, aspergillosis, and other inflammatory disorders. Endocrine and metabolic diseases included diabetic ketoacidosis and other endocrine or metabolic disorders. Other diagnoses included cases that could not be classified into the predefined disease categories. Each dog was assigned to only one primary disease classification to allow comparison of anemia characteristics among disease groups.

5. Classification of anemia severity: Anemia severity was classified according to PCV values based on previously described criteria (Feldman et al. 2000). Dogs were categorized as having mild (PCV 30-36%), moderate (PCV 20-29%), severe (PCV 13-19%), or very severe anemia (PCV <13%). The distribution of anemia severity was evaluated among disease classifications (Tvedten, 2022).

6. Statistical analysis: Categorical variables were presented as numbers and percentages. The distributions of disease classifications, primary diagnoses, concurrent diseases, and anemia severity were summarized using descriptive statistics. Differences in anemia severity among disease classifications were assessed using the Fisher–Freeman–Halton exact test with Monte Carlo simulation. A p -value <0.05 was considered statistically significant.

Results

A total of 4,682 dogs were identified from the Clinical Laboratory database of the Veterinary Teaching Hospital, Faculty of Veterinary Medicine, Khon Kaen University, Thailand, between January and December 2024. Medical records and hematologic results were retrospectively reviewed. Dogs with a packed cell volume (PCV) $\geq 37\%$ and cases with incomplete diagnostic or hematologic information were excluded. Of the remaining dogs, 1,252 (26.7%) were identified as anemic (PCV $< 37\%$). Subsequently, dogs younger than six months of age and those diagnosed with acute blood loss were excluded. The final study population consisted of 1,013 (21.6%) anemic dogs. The distributions of disease classifications, anemia severity, primary diagnoses, and concurrent diseases in anemic dogs are presented in the following sections.

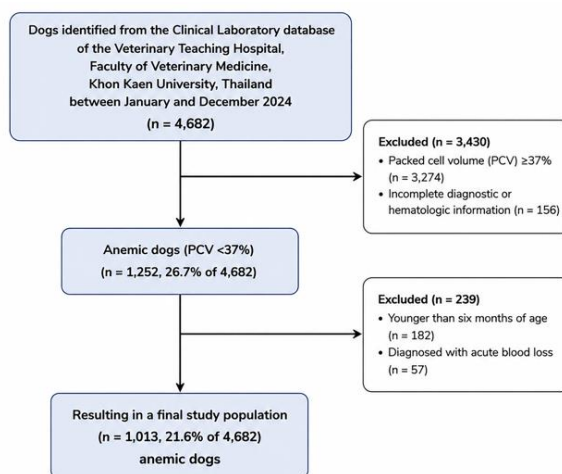


Fig. 1 Flow diagram of the study population.

1. Distribution of disease classifications and primary diagnoses

The distribution of disease classifications showed that neoplasia was the most frequently identified disease classification, accounting for 24.9% (252/1,013) of cases, followed by vector-borne infectious diseases (20.2%, 205/1,013), CKD (16.6%, 168/1,013), and other diagnoses (15.6%, 158/1,013).

Systemic bacterial infectious diseases and inflammatory diseases accounted for 8.4% (85/1,013) and 7.7% (78/1,013) of cases, respectively, whereas immune-mediated diseases, endocrine and metabolic diseases, and bone marrow disorders each accounted for less than 5% of cases (Figure 2).

2. Severity of anemia according to disease classification

Among the 1,013 anemic dogs, mild anemia was the most common severity (568/1,013; 56.1%), followed by moderate anemia (336/1,013; 33.2%). Severe (80/1,013; 7.9%) and very severe anemia (29/1,013; 2.9%) were less common. Anemia severity was significantly associated with disease classification (Fisher–Freeman–Halton exact test with Monte Carlo simulation, $p < 0.0001$) (Table 1). Mild anemia was the predominant severity in five of the nine disease classifications, including neoplasia (175/252; 69.4%), CKD (87/168; 51.8%), inflammatory diseases (54/78; 69.2%), endocrine and metabolic diseases (16/26; 61.5%), and other diagnoses (114/158; 72.2%). By contrast, moderate anemia predominated in dogs with vector-borne infectious diseases (88/205; 42.9%), systemic bacterial infectious diseases (40/85; 47.1%), and immune-mediated diseases (17/36; 47.2%). Bone marrow disorders had the highest proportions of severe and very severe anemia, with each accounting for 40.0% (2/5) of cases, whereas mild anemia was not observed in this disease classification.

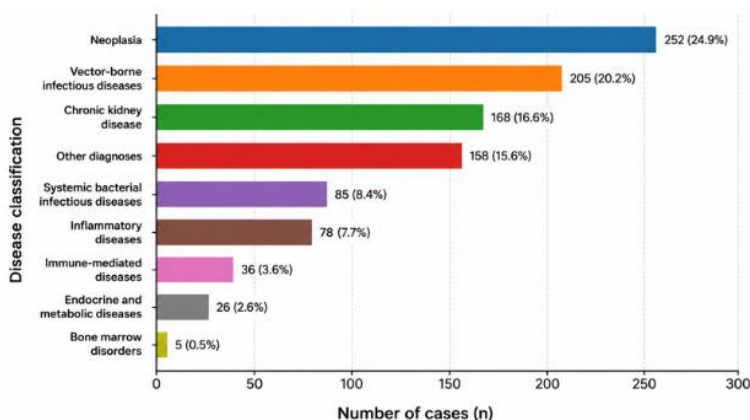


Fig. 2 Distribution of disease classifications among canine anemia cases.

Table 1 Severity of anemia according to disease classification

Causes of anaemia	Mild anemia	Moderate anemia	Severe anemia	Very severe anemia	Total
Vector-borne infectious diseases	80 (39.0%)	88 (42.9%)	26 (12.7%)	11 (5.4%)	205
Neoplasia	175 (69.4%)	66 (26.2%)	8 (3.2%)	3 (1.2%)	252
Systemic bacterial infectious diseases	36 (42.4%)	40 (47.1%)	5 (5.9%)	4 (4.7%)	85
Chronic kidney disease	87 (51.8%)	59 (35.1%)	19 (11.3%)	3 (1.8%)	168
Immune-mediated diseases	6 (16.7%)	17 (47.2%)	10 (27.8%)	3 (8.3%)	36
Inflammatory diseases	54 (69.2%)	20 (25.6%)	4 (5.1%)	0 (0.0%)	78
Bone marrow disorders	0 (0.0%)	1 (20.0%)	2 (40.0%)	2 (40.0%)	5
Endocrine and metabolic diseases	16 (61.5%)	10 (38.5%)	0 (0.0%)	0 (0.0%)	26
Other diagnoses	114 (72.2%)	35 (22.2%)	6 (3.8%)	3 (1.9%)	158
Total	568 (56.1%)	336 (33.2%)	80 (7.9%)	29 (2.9%)	1,013 (100%)

Data are presented as n (%). Percentages in the disease classification rows were calculated within each disease classification. Percentages in the total row (italicized) were calculated based on the total number of anemic dogs (n = 1,013).

3. Primary diagnoses of anemic dogs

Among the 1,013 anemic dogs included in the study, CKD was the most common primary diagnosis, accounting for 15.8% (160/1,013), followed by ehrlichiosis (9.3%, 94/1,013), mast cell tumor (MCT) (5.5%, 56/1,013), pyometra (4.3%, 44/1,013), lymphoma (4.0%, 41/1,013), pancreatitis (3.8%, 39/1,013), myxomatous mitral valve disease (MMVD) (3.5%, 35/1,013), anaplasmosis (3.4%, 34/1,013), immune-mediated hemolytic anemia (IMHA) (2.4%, 24/1,013), and transmissible venereal tumor (TVT) (1.8%, 18/1,013) (Table 2). Each of the remaining primary diagnoses accounted for less than 1% of the study population.

Table 2 Primary diagnoses of anemic dogs.

Primary diagnosis	Number	% (n = 1,013)
Chronic kidney disease (CKD)	160	15.8
Ehrlichiosis	94	9.3
Mast cell tumor	56	5.5
Pyometra	44	4.3
Lymphoma	41	4.0
Pancreatitis	39	3.8
Myxomatous mitral valve disease (MMVD)	35	3.5
Anaplasmosis	34	3.4
Immune-mediated hemolytic anemia (IMHA)	24	2.4
Transmissible venereal tumor (TVT)	18	1.8

The table presents the most common primary diagnoses. All remaining primary diagnoses each represented less than 1% of the total study population.

4. Concurrent diseases in anemic dogs

The most common concurrent diseases associated with each primary diagnosis are presented in Table 3. Dogs with primary CKD exhibited the greatest diversity of concurrent diseases, including single-, double-, and multi-disease combinations. Ehrlichiosis was the most frequently identified concurrent disease in dogs with CKD (33/160; 20.6%), followed by pancreatitis (24/160; 15.0%) and coinfection with ehrlichiosis and anaplasmosis (17/160; 10.6%). In dogs with primary ehrlichiosis, anaplasmosis was the most common concurrent disease (54/94; 57.4%), followed by babesiosis (4/94; 4.3%). Mild anemia predominated among dogs with concurrent CKD and pancreatitis (15/24), whereas concurrent CKD and ehrlichiosis were observed across all anemia severity categories. Coinfections involving ehrlichiosis and anaplasmosis were identified in several primary diagnoses, including concurrent pancreatitis in a small number of dogs.

Table 3 Most common concurrent diseases and anemia severity

Concurrent disease		Mild	Moderate	Severe	Very severe	*Total, n (%)
Chronic kidney disease (CKD)	Ehrlichiosis	12	13	7	1	33 (20.6)
	Pancreatitis	15	9	0	0	24 (15.0)
	MMVD [‡]	1	2	1	0	4 (2.5)
	Ehrlichiosis, Anaplasmosis	6	6	5	0	17 (10.6)
	Ehrlichiosis, Pancreatitis	1	2	1	1	5 (3.1)
	Ehrlichiosis, Anaplasmosis, Pancreatitis	1	1	1	0	3 (1.9)
Ehrlichiosis	Anaplasmosis	21	25	5	3	54 (57.4)
	Babesiosis	0	3	0	1	4 (4.3)
	Anaplasmosis, Pancreatitis	0	1	0	0	1 (1.1) [†]
Pyometra	Acute kidney injury	3	0	0	0	3 (6.8)
	Ehrlichiosis	0	3	0	0	3 (6.8)
	Sepsis	0	3	0	0	3 (6.8)
	Ehrlichiosis, Anaplasmosis	1	3	0	0	4 (9.1)
Pancreatitis	Ehrlichiosis	2	1	0	0	3 (7.7)
Immune-mediated hemolytic anemia (IMHA)	Pancreatitis	1	2	1	0	4 (16.7)

* Percentages were calculated using the number of dogs within each primary diagnosis as the denominator (N = 1,013). [‡] MMVD = myxomatous mitral valve disease.

[†] Only the most common concurrent disease combinations are shown. Combinations with <3 cases were excluded, except for clinically relevant vector-borne co-infections.

Discussion

The results of our retrospective study demonstrate that neoplasia was the most common disease classification associated with anemia (24.9%), followed by vector-borne infectious 20.2%. Neoplasia was reported to be a common cause of anemia (Chervier et al., 2012; Liu & Su, 2015). This finding is consistent with the pathophysiology of cancer-associated anemia, which typically develops gradually as a manifestation of chronic disease (Chikazawa & Dunning, 2016). Persistent inflammation associated with neoplastic conditions promotes the

production of pro-inflammatory cytokines, leading to impaired erythropoietin responsiveness and suppression of erythropoiesis (Weiss et al., 2019). In addition, chronic occult blood loss, nutritional deficiencies, and aging in dogs may also contribute to anemia in affected dogs.

Vector-borne infectious diseases accounted for 20.2% of anemic dogs in the present study. This prevalence was comparable to that reported in France (17.2%) by Bouzouraa et al. (2017), but lower than the approximately 30% reported by Lippi et al. (2021). The prevalence of vector-borne infections observed in this study may reflect the endemicity of tick-borne pathogens in Thailand. *Ehrlichia* spp. is an important cause of canine anemia, which may result from immune-mediated erythrocyte destruction, hemorrhage secondary to thrombocytopenia, bone marrow suppression, or a combination of these mechanisms (Little, 2010). Differences across studies may reflect variation in pathogen endemicity, vector distribution, diagnostic methods, and study populations (Bouzouraa et al., 2017).

When the severity of anemia was evaluated, distinct patterns were observed across disease categories. Mild anemia predominated in dogs with CKD and neoplasia, consistent with anemia associated with chronic disease. Moderate anemia was more frequently observed in dogs with vector-borne infectious and immune-mediated diseases, reflecting the underlying pathophysiology. In CKD, anemia develops gradually due to persistent inflammation, shortened erythrocyte lifespan, and the inhibitory effects of uremic toxins on erythropoiesis (Borin-Crivellenti et al., 2023; Lippi et al., 2021). Moreover, infectious and immune-mediated diseases often result in a more rapid reduction in circulating erythrocytes through hemolysis, hemorrhage, or both (Garden et al., 2019). Although bone marrow disorders accounted for a small proportion of anemic dogs in the present study, they were associated with the most severe hematologic abnormalities, consistent with impaired hematopoiesis due to primary or secondary bone marrow disease (Little, 2010).

This finding reflects the marked reduction in erythrocyte production associated with bone marrow failure, in contrast to diseases in which anemia results from erythrocyte destruction or blood loss (Grimes & Fry, 2015). Bone marrow disorders also frequently affect multiple hematopoietic cell lines, explaining the severe hematologic abnormalities observed in the present study (Weiss, 2006).

Concurrent diseases were frequently identified in anemic dogs, particularly among those with CKD, which exhibited the greatest diversity of concurrent disease combinations. Ehrlichiosis was the most common concurrent disease in dogs with CKD, whereas CKD was also frequently identified in dogs with *Ehrlichia* spp. infection, consistent with previous studies suggesting that chronic ehrlichiosis may contribute to renal injury through immune complex deposition (Burton et al., 2020; Crivellenti et al., 2021). In contrast, anaplasmosis was the most common concurrent disease in dogs with ehrlichiosis, reflecting the endemic nature of tick-borne diseases in northeastern Thailand and the potential for coinfection in areas with high tick exposure. These findings suggest that concurrent diseases may be associated with differences in anemia severity in some disease groups; however, the retrospective study design limits interpretation of this relationship, and it cannot be determined whether these concurrent diseases contributed to these differences. Collectively, these findings indicate that anemia is frequently influenced by multiple concurrent pathological processes rather than a single underlying disease, highlighting the importance of investigating comorbid conditions during the diagnostic evaluation of anemic dogs.

The predominance of ehrlichiosis and anaplasmosis is relevant because both infections can contribute to anemia through chronic inflammation, bone marrow suppression, and immune-mediated abnormalities (Gaunt et al., 2010; Little, 2010). CKD concurrent with pancreatitis was mainly associated with mild anemia, whereas CKD concurrent with ehrlichiosis occurred across all anemia

severity categories. This suggests that the specific comorbid condition may influence anemia severity beyond CKD alone. The more severe anemia observed with ehrlichiosis may be related to its potential to cause bone marrow suppression (Mylonakis et al., 2019). Further prospective studies are needed to confirm this association. This study has several limitations. The retrospective, single-center design may have introduced selection bias and limited the generalizability of the findings to other veterinary populations and clinical settings. In addition, the study relied on information available in existing medical records, and some clinical or diagnostic information may have been incomplete.

Overall, the findings indicate that the severity and hematologic presentation of anemia varied across different disease classifications and concurrent conditions. The frequent occurrence of concurrent diseases, particularly vector-borne infections and CKD, highlights the multifactorial nature of anemia in dogs. Together, these findings provide useful information on the clinical presentation of anemia and the diseases associated with anemia in dogs.

References

- Behrend, E., Holford, A., Lathan, P., Rucinsky, R., & Schulman, R. (2018). 2018 AAHA Diabetes Management Guidelines for Dogs and Cats. *Journal of the American Animal Hospital Association*, 54(1), 1-21. Doi: 10.5326/JAAHA-MS-6822.
- Borin-Crivellenti, S., Crivellenti, L. Z., Gilor, C., Gilor, S., Silva, D. G., Maia, S. R., Costa, P. B., Alvarenga, A. W. O., Fernandes, A. L. S., & Santana, A. E. (2023). Anemia in canine chronic kidney disease is multifactorial and associated with decreased erythroid precursor cells, gastrointestinal bleeding, and systemic inflammation. *American Journal of Veterinary Research*, 84(10), 1-6. Doi: 10.2460/ajvr.23.05.0097.

- Bouzouraa, T., Cadore, J. L., Chene, J., Goy-Thollot, I., Ponce, F., Chalvet-Monfray, K., Rannou, B., & Chabanne, L. (2017). Implication, clinical and biological impact of vector-borne haemopathogens in anaemic dogs in France: a prospective study. *Journal of Small Animal Practice*, 58(9), 510-518. Doi: 10.1111/jsap.12690.
- Burton, W., Drake, C., Ogeer, J., Buch, J., Mack, R., McCrann, D., & Coyne, M. J. (2020). Association Between Exposure to Ehrlichia spp. and Risk of Developing Chronic Kidney Disease in Dogs. *Journal of the American Animal Hospital Association*, 56(3), 159-164. Doi: 10.5326/JAAHA-MS-7012.
- Parachini-Winter, C., Carioto, L. M., & Gara-Boivin, C. (2019). Retrospective evaluation of anemia and erythrocyte morphological anomalies in dogs with lymphoma or inflammatory bowel disease. *Journal of the American Veterinary Medical Association*, 254(4), 487-495. Doi: 10.2460/javma.254.4.487.
- Chervier, C., Cadoré, J. L., Rodriguez-Piñeiro, M. I., Deputte, B. L., & Chabanne, L. (2012). Causes of anaemia other than acute blood loss and their clinical significance in dogs. *Journal of Small Animal Practice*, 53(4), 223-227. Doi: 10.1111/j.1748-5827.2011.01191.x.
- Chikazawa, S., & Dunning, M. D. (2016). A review of anaemia of inflammatory disease in dogs and cats. *The Journal of small animal practice*, 57(7), 348-353. Doi: 10.1111/jsap.12498.
- Crivellenti, L. Z., Cintra, C. A., Maia, S. R., Silva, G. E. B., Borin-Crivellenti, S., Cianciolo, R., Adin, C. A., Tinucci-Costa, M., Pennacchi, C. S., & Santana, A. E. (2021). Glomerulotubular pathology in dogs with subclinical ehrlichiosis. *PLOS ONE*, 16(12), e0260702. Doi: 10.1371/journal.pone.0260702.
- Elliott, J. & White, J. (2023). *IRIS Staging System: Overview of the IRIS staging system for CKD*. Retrieved August 9, 2026 from <https://www.iris-kidney.com/iris-staging-system>.

- Fabrès, V., Dossin, O., Reif, C., Campos, M., Freiche, V., Maurey, C., Pilot-Storck, F., Desquillet, L., & Benchekroun, G. (2019). Development and validation of a novel clinical scoring system for short-term prediction of death in dogs with acute pancreatitis. *Journal of Veterinary Internal Medicine*, 33(2), 499-507. Doi: 10.1111/jvim.15421.
- Feldman, B. F., Zinkl, J. G., Jain, N. C., & Schalm, O. W. (2000). Veterinary hematology. In Feldman, B. F., Zinkl, J. G., & Jain, N. C. (Eds.), *Schalm's veterinary hematology* (5th ed.). Lippincott Williams & Wilkins.
- Garden, O. A., Kidd, L., Mexas, A. M., Chang, Y. M., Jeffery, U., Blois, S. L., Fogle, J. E., MacNeill, A. L., Lubas, G., Birkenheuer, A., Buoncompagni, S., Dandrieux, J. R. S., Di Loria, A., Fellman, C. L., Glanemann, B., Goggs, R., Granick, J. L., LeVine, D. N., Sharp, C. R., Smith-Carr, S., Swann, J. W., & Szladovits, B. (2019). ACVIM consensus statement on the diagnosis of immune-mediated hemolytic anemia in dogs and cats. *Journal of Veterinary Internal Medicine*, 33(2), 313-334. Doi: 10.1111/JVIM.15441.
- Gaunt, S. D., Beall, M. J., Stillman, B. A., Lorentzen, L., Diniz, P. P. V. P., Chandrashekar, R., & Breitschwerdt, E. B. (2010). Experimental infection and co-infection of dogs with *Anaplasma platys* and *Ehrlichia canis*: Hematologic, serologic and molecular findings. *Parasites and Vectors*, 3(1), 1-10. Doi: 10.1186/1756-3305-3-33.
- Girardi, A. F., Campos, A. N., Pescador, C. A., De Almeida, A. D. B. P. F., Mendonça, A. J., Nakazato, L., De Oliveira, A. C. S., & Sousa, V. R. F. (2017). Quantitative analysis of bone marrow in pancytopenic dogs. *Semina: Ciências Agrárias*, 38(6), 3639-3646. Doi: 10.5433/1679-0359.2017v38n6p3639.
- Grimes, C. N., & Fry, M. M. (2015a). Nonregenerative Anemia: Mechanisms of Decreased or Ineffective Erythropoiesis. *Veterinary Pathology*, 52(2), 298-311. Doi: 10.1177/0300985814529315.

- Lippi, I., Perondi, F., Lubas, G., Gori, E., Pierini, A., D'addetta, A., & Marchetti, V. (2021). Erythrogram patterns in dogs with chronic kidney disease. *Veterinary Sciences*, 8(7), 123. Doi: 10.3390/vetsci8070123.
- Little, S. E. (2010). Ehrlichiosis and Anaplasmosis in Dogs and Cats. *Veterinary Clinics of North America: Small Animal Practice*, 40(6), 1121-1140. Doi: 10.1016/j.cvsm.2010.07.004.
- Liu, P. C., & Su, B. L. (2015). CAUSES OF CANINE ANEMIA IN TAIWAN: A FIVE-YEAR RETROSPECTIVE SURVEY. *Taiwan Veterinary Journal*, 41(1), 31-37. Doi: 10.1142/s1682648515500031.
- Mylonakis, M. E., Harrus, S., & Breitschwerdt, E. B. (2019). An update on the treatment of canine monocytic ehrlichiosis (*Ehrlichia canis*). *The Veterinary Journal*, 246, 45-53. Doi: 10.1016/j.tvjl.2019.01.015.
- Neer, T. M., Breitschwerdt, E. B., Greene, R. T., & Lappin, M. R. (2002). Consensus Statement on Ehrlichial Disease of Small Animals from the Infectious Disease Study Group of the ACVIM. *Journal of veterinary internal medicine*, 16(3), 309-315. Doi: 10.1111/j.1939-1676.2002.tb02374.x.
- Paltrinieri, S. (2014). The diagnostic approach to anaemia in the dog and cat. *Journal of the Hellenic Veterinary Medical Society*, 65(3), 149-164. Doi: 10.12681/jhvms.15529.
- Stokol, T. (2024). Fluid Analysis: Thoracic, Abdominal, Joint. In Ettinger, S. J., Feldman, E. C., & Côté, E. (Eds.), *Ettinger's Textbook of Veterinary Internal Medicine* (9th ed., Vol. 1, pp. 340-352). Elsevier.
- Thongsahuan, S., Chethanond, U., Wasiksiri, S., Saechan, V., Thongtako, W., & Musikacharoen, T. (2020). Hematological profile of blood parasitic infected dogs in Southern Thailand. *Veterinary World*, 13(11), 2388-2394. Doi: 10.14202/VETWORLD.2020.2388-2394.
- Tvedten, H. (2022). Classification and Laboratory Evaluation of Anemia. In Brooks, M. B., Harr, K. E., Seelig, D. M., Wardrop, K. J., & Weiss, D. J. (Eds.), *Schalm's Veterinary Hematology* (7th edition, pp. 198-208). John Wiley & Sons. Doi: 10.1002/9781119500537.ch25.

- Weiss, D. J. (2006). A Retrospective Study of the Incidence and the Classification of Bone Marrow Disorders in the Dog at a Veterinary Teaching Hospital (1996-2004). *Journal of Veterinary Internal Medicine*, 20(4), 955-961. Doi: 10.1111/j.1939-1676.2006.tb01811.x.
- Weiss, G., Ganz, T., & Goodnough, L. T. (2019). Anemia of inflammation. *Blood*, 133(1), 40-50. Doi: 10.1182/blood-2018-06-856500.