Canine Infectious Respiratory Disease Outbreak at a Private Shelter with Municipal Contracts

(Shelter Medicine Practice Category: Medical Health - Outbreak Management)

Introduction:

Canine infectious respiratory disease (CIRD) is a multifactorial disease that is common in shelter dogs.[1] Although CIRD is characterized by low mortality and is often self-limiting, morbidity can be substantial in the shelter environment. Factors such as crowding, stress, prolonged length of stay (LOS), poorly designed facilities and housing areas, improper vaccination, insufficient staff training, and the absence of disease control and sanitation protocols all increase transmission risk and disease severity. Additional risk factors include age, immune status, co-morbidities, and high environmental pathogen load.[2]

Viral CIRD pathogens include canine parainfluenza virus (CPiV), adenovirus-2 (CAV-2), distemper virus (CDV), influenza virus (CIV), pneumovirus (CPnV), respiratory coronavirus, and herpesvirus, with viruses commonly identified as primary pathogens in shelter dogs.[3] Bacterial pathogens include Streptococcus equi subsp. zooepidemicus (Strep.zoo), Bordetella bronchiseptica (Bb), and Mycoplasma cynos (M.cynos), with Strep.zoo often reported as a primary pathogen and Bb and M.cynos acting as primary or secondary pathogens.[2] Many CIRD pathogens are detected in asymptomatic dogs.[1] Seroconversion rates increase with prolonged LOS, and dogs may be infected with a single or multiple pathogens concurrently.[2] No published peer-reviewed studies have described the prevalence of CIRD pathogens in Australian shelters.

CIRD pathogens are primarily transmitted through aerosols, potentially spreading up to 20 feet, while larger droplets typically spread within a 5-foot radius, contaminating surfaces and fomites.[2] Infection begins with colonization of the upper respiratory epithelium, impairing mucociliary clearance and increasing susceptibility to secondary bacterial invasion.[2] Most CIRD pathogens have incubation periods of up to 10 days.[4] Quarantine of exposed dogs is often unnecessary and may inadvertently prolong LOS, contributing to overcrowding, stress, and increased infectious disease risk. However, it may be indicated when CDV or CIV are suspected, or in an outbreak.[2] Shedding duration varies widely, ranging from weeks to months.[2]

Clinical signs include coughing, nasal and ocular discharge, pyrexia and lethargy. Differentials include lungworm infection, chronic or allergic bronchitis, and foreign body aspiration. CIRD is typically a presumptive diagnosis in shelters based on clinical signs.

Diagnostic testing should be considered in shelters when disease prevalence, severity, and mortality increase. Tests include PCR, bacterial culture and sensitivity, serology, virus isolation, and histopathology or necropsy.[2] In outbreaks, clinicians should sample 10 – 30% of acutely affected animals.[2] Results should be interpreted with consideration of potential vaccination interference and incidental detection of non-causative pathogens. False-negative results could occur due to sampling errors, inappropriate patient selection, or improper sample handling.[2]

Treatment, Management and Prognosis

Although most primary CIRD are viral infections, empiric antimicrobial therapy is frequently prescribed in shelters due to population health concerns and the increased risk of secondary bacterial infection associated with stress. Doxycycline remains the preferred first-line

antimicrobial (5 – 10 mg/kg PO q12 – 24h for 7 – 10 days). Supportive treatments may include antitussives, anti-inflammatory medication, intravenous fluid therapy, nutritional support, oxygen therapy, nebulization, and coupage.[2]

Symptomatic dogs should be isolated until clinical signs are resolved. Strict biosecurity and sanitation protocols are essential to limit transmission between animals. Staff should use personal protective equipment (PPE) and practice hand hygiene when handling and cleaning around infected and exposed animals.[2] Sodium hypochlorite and accelerated hydrogen peroxide are broadly effective disinfectant options, whereas quaternary ammonium compounds have limited efficacy against Bb and CAV-2.[2] Appropriate facility design elements including functional isolation wards, an effective ventilation system, and double-compartment housing units, further minimize transmission risks.[2]

Canine core vaccines (canine parvovirus, CAV-2, CDV, intranasal Bb/CPiV) should be administered on intake to reduce the severity of clinical signs and shedding duration.[2] Intranasal CPiV and Bb vaccines are preferred over parenteral vaccines for their rapid onset of immunity and greater efficacy.[5] Population management strategies that minimize population density, stress, and LOS, such as managed intake, implementing capacity-for-care models, daily rounds, and pathway planning also limit CIRD.[2]

Case History and Presentation

The author served as a part-time shelter veterinarian at a private shelter with municipal contracts in Australia. Shelter animals were co-managed by five shelter veterinarians working rotating shifts daily. The shelter admitted approximately 13,000 animals annually, including cats, dogs, small mammals, livestock, and wildlife, from owner surrenders, strays, and cruelty investigations. Annual dog intake averaged 3500, with approximately 150 dogs housed on-site.

Kennel attendants were responsible for feeding, cleaning, walking, providing enrichment, and assisting with veterinary examinations. Six to eight kennel staff were rostered daily, and time constraints were frequently reported, particularly for walking and enrichment. Medical examinations were occasionally delayed or missed due to the high dog population and limited veterinary availability. The average LOS for dogs was approximately 60 days.

The facility consisted of 240 kennels across ten pods of 20, plus 40 adoption kennels. Each measured 3.6 x 3.3 meters, with double-compartment units reserved for large breeds. The shelter lacked dedicated medical quarantine and isolation wards. Dogs with unknown vaccination history received a modified-live virus canine core vaccine[a] and an intranasal live-attenuated vaccine[b] within 24 – 72 hours of admission. No formal population management strategies or daily health and behavior monitoring were in place.

Prior to the outbreak, the shelter typically managed five to ten mild CIRD cases at a time. No previous outbreaks had been reported, and no formal protocols existed for managing CIRD and disease outbreaks. Symptomatic dogs remained confined to their kennels, with movement through the shelter suspended until release from isolation.

On August 2nd, 2023, the author examined a 9-month-old male intact Labradoodle (996515) with acute onset of inappetence, lethargy, and vomiting. The patient was quiet but alert, with pink but tacky mucous membrane, estimated 5% dehydration. Vital parameters included an elevated temperature (40.3°C), mild tachycardia (120 beats/minute), moderate tachypnea (108 breaths/minute) and increased respiratory effort. Severe mucopurulent nasal discharge and abdominal tension were noted. The working diagnosis was viral and/or bacterial respiratory infection with possible gastrointestinal diseases, caused by infection (viral/bacterial) or foreign body.

Hematology, biochemistry tests, and thoracic and abdominal radiographs were performed. Bloodwork demonstrated evidence of inflammation or infection (Table 1). Thoracic radiographs revealed a patchy alveolar pattern within the cranioventral lung field consistent with infectious pneumonia (viral and/or bacterial). (Figure 1) Abdominal radiographs were unremarkable. Vomiting was considered more likely secondary to airway irritation from coughing and the trigger of the gag reflex than gastrointestinal causes.

Case Management and Outcome

Treatment for 996515 included intravenous fluid therapy, buprenorphine (0.02 mg/kg q8h IV), maropitant (1mg/kg q24h IV) and amoxicillin (22 mg/kg q12h IV). Doxycycline was prescribed at 10 mg/kg PO q24h for 10 days after patient regained appetite. Due to the absence of a hospital isolation ward, the patient was housed in a high-traffic clinic area separated from the main wards. Biosecurity signage was placed on the cage, and PPE use was required for all personnel handling the patient.

Upon suspicion of an infectious cause, the author instructed kennel attendants to monitor other dogs for CIRD symptoms. Dogs housed adjacent to symptomatic individuals or with direct contact were considered exposed. Infected dogs were defined as those exhibiting CIRD symptoms and diagnosed by a veterinarian. A total of 34 infected and 14 exposed dogs were identified. Treatment regimens varied among clinicians, with most dogs receiving doxycycline (5 – 10 mg/kg PO q12 – 24h for 7 – 10 days). Some dogs also received codeine (1 – 2mg/kg PO q12h for 5 days) and meloxicam (0.1mg/kg PO q24h for 5 days) (Table 2).

Given the large number of infected dogs, a CIRD outbreak was suspected. The author recommended PCR testing of one-third of affected dogs (n=11). However, only five tests were approved by leadership due to cost and PCR limitations. The author delegated sample

collection and patient selection requirements to the welfare veterinarian on duty. For unknown reasons, only four samples were collected and submitted to a reference laboratory[c] on August 3rd.

The author developed an outbreak response plan including alternative isolation and quarantine housing options and biosecurity measures. In the absence of dedicated medical isolation and quarantine wards, the most affected pod was converted to house infected dogs, and the second-most affected pod to house both infected and exposed dogs, separated by at least two empty kennels (> 6 meters). Healthy, unexposed dogs continued pathway movement through the shelter. Biosecurity signage was posted at the pod entrances to limit foot traffic. The use of PPE including disposable gowns, gloves, and shoe covers were required. Dedicated kennel attendants were assigned to these pods, instructed to clean and feed the exposed dogs followed by the infected dogs. Additional staffing was recommended but denied by leadership due to budget constraints.

A 10-day quarantine was enacted for exposed dogs, with plans to adjust based on PCR results, disease progression, and mortality trends.

Infected dogs were confined until clinical resolution and veterinary clearance. Daily enrichment was recommended to support the psychological well-being during confinement. The sanitation protocol was reviewed and modified by the author, replacing the current quaternary ammonium[d] disinfectant with accelerated hydrogen peroxide[e] (1:16 dilution, 5 minutes contact time), with spot cleaning during confinement, and full decontamination upon release.

PCR results returned on August 9, with one positive sample (CPnV and M. cynos) and three negative samples. This was insufficient to determine the causative agent(s) of the outbreak, although outbreaks caused by M.cynos and CPnV (alone or in combination) have been

reported.[3] Based on the PCR results, the author recommended avoiding the use of amoxicillin-clavulanate as a first-line empiric antibiotic due to M.cynos resistance. Mildly affected dogs could be fast-tracked to adoption. The quarantine recommendation for exposed dogs was lifted due to the unlikelihood of CIV, CDV and Strep.zoo given the clinical severity, disease progression, and mortality observed throughout the outbreak period.

Of the 34 affected patients, only 996515 developed pneumonia and required hospitalization. Seventeen dogs recovered with medical treatment, eleven without, and five were not examined by a veterinarian despite reported illness. No exposed dogs developed clinical signs, and none were placed in foster care due to the lack of emergency medical foster availability.

Long-term recommendations included standardized diagnostic testing and treatment protocols, purpose-built medical isolation wards, and emergency foster programs to reduce staff burden and prolonged LOS. Ongoing focus remains on effective population management to minimize LOS, stress, and infectious disease transmission and prevalence among the shelter population.

Discussion:

Multiple compounding factors contributed to the scale of the CIRD outbreak. Reflection on the author's management identified areas for improvement. The decision to quarantine all exposed animals resulted in an unnecessary prolongation of LOS. While concerns regarding emerging or high-mortality pathogens initially justified this approach, later clinical patterns and presenting signs were inconsistent with CIV and CDV.

Only five PCR tests were approved, with four samples ultimately submitted. This limited number of diagnostic tests was insufficient to characterize the outbreak or meaningfully guide management decisions, limiting the clinical utility of the results. The negative PCR findings may reflect limitations of this highly sensitive test, which can be influenced by sample

collection technique, handling, and timing of testing, highlighting the need for improved training in diagnostic sampling. In retrospect, delaying testing until further outbreak progression may have strengthened the justification for broader testing and improved diagnostic yield.

Early release and implementation of a drafted CIRD protocol may have improved consistency in case management. Evidence supporting codeine and anti-inflammatory use in shelter CIRD is limited, and many cases may resolve with supportive care alone. Reducing reliance on these medications could also decrease the handling associated with medicating infected dogs. Furthermore, the author should have facilitated a structured post-outbreak debrief to evaluate management gaps and improve preparedness. Future infectious disease management should focus on the implementation of standardized operating procedures, ongoing staff training and development, and the establishment of purposed-built medical quarantine and isolation wards. Effective population management using a capacity-for-care framework, combined with reductions in LOS through the identification of operational bottlenecks and more efficient pathway planning supported by daily rounds, could further reduce the prevalence of CIRD within the shelter.

References

1. Lavan R, Knesl O. Prevalence of canine infectious respiratory pathogens in asymptomatic dogs presented at US animal shelters. *J Small Anim Pract*. 2015;56(9):572-576.

2. Miller L, Janeczko S, Hurley KF. *Infectious Disease Management in Animal Shelters, 2nd Edition (CIRD Chapter)*. Vol Canine Infectious Respiratory Disease (CIRD). 2ND ed. WILEY Blackwell; 2021.

3. Crawford C. Canine Respiratory Infections in Shelters. UF Maddie's Shelter Medicine Program. 2021. Accessed October 7, 2024. https://sheltermedicine.vetmed.ufl.edu/wordpress/files/2022/03/Gatorland-CIRD-Diagnosis-and-Treatment-SOP.pdf

4. Reagan KL, Sykes JE. Canine Infectious Respiratory Disease. *Vet Clin North Am Small Anim Pract*. 2020;50(2):405-418.

5. Squires RA, Crawford C, Marcondes M, Whitley N. 2024 guidelines for the vaccination of dogs and cats – compiled by the Vaccination Guidelines Group (VGG) of the World Small Animal Veterinary Association (WSAVA). *J Small Anim Pract*. 2024;65(5):277-316.

Endnotes

[a] Nobivac® DHP Merck & Co., Inc., Rahway, NJ, USA and its affiliates.

[b] Nobivac® KC Merck & Co., Inc., Rahway, NJ, USA and its affiliates.

[c] IDEXX Laboratories, Inc., Westbrook, Maine, U.S.A.

[d] F10 SC Veterinary Disinfectant; Health and Hygiene (Pty) LTD, South Africa.

[e] Oxivir, 2024 Diversey, Inc. AHP® Charlotte, NC 28219-0747 U.S.A.

Tables and Figures:

Table 1. 996515 Hematology and biochemistry results on August 2nd, 2023.

Test	Laboratory Value	Normal Reference
Erythrocytes		
RBC	6.68	5 65-8.87x10 ^12/L
Haematocrit	0.399	0.373 - 0.617 L/L
Haemoglobin	138	131 - 205 g/L
MCV	59.7	61.6 - 73.5 fL
MCH	20.7	21.2 - 25.9 pg
MCHC	346	320 - 379 g/L
RDW 13.6 - 21.7 %	16.3	13.6 - 21.7 %
% Reticulocyte	2.0%	
Reticulocytes	136.3	10.0 - 110.0 K/µL
Reticulocyte Haemoglobin (#)	21.3	22.3 - 29.6 pg
Leukocytes		
WBC % Neutrophils * 79.4 % % Lymphocytes * 12.4 % % Monocytes * 7.9 % % Eosinophils 0.2 % % Basophils 0.1 %	18.99	5.05 - 16.76 x10^9/L
Neutrophils	15.10	2.95 - 11.64 x10^9/L

Bands *Suspected		
Lymphocytes	2.35	1.05 - 5.10 x10^9/L
Monocytes	1.50	0.16 - 1.12 x10^9/L
Eosinophils	0.03	0.06 - 1.23 x10^9/L
Basophils	0.01	0.00 - 0.10 x10^9/L
Thrombocytes		
Platelets	218	148 - 484 x10^9/L
PDW	13.7	9.1 - 19.4 fL
MPV	12.8	8.7 - 13.2 fL
Plateletcrit	0.28	0.14 - 0.46 %
Serum Chemistry		
Glucose	5.66	4.11 – 7.95 mmol/L
Creatinine	59	44 - 159 µmol/L
Urea	1.9	2.5 – 9.6 mmol/L
Total Protein	71	52-82 g/L
Albumin	34	23 - 40 g/L
Globulin	37	25 - 45 g/L
Albumin: Globulin Ratio	0.9	
ALT	26	10 - 125 U/L
ALP	201	23 - 212 U/L

Table 2. A summary of infected and exposed dogs by Aug 6th, 2023. CIRD clinical signs noted by staff may include any of the following signs: coughing, nasal discharge, ocular discharge, and tracheal pinch positive.

Abbreviations:

N/A: not applicable; AA: Animal Attendant; ms: months old; ys: years old; I: infected; E: exposed; < 8/3: clinical signs flagged by animal attendants before August 3rd, but unsure of the exact date; N: none; T: treated.

Location	Animal ID	Age	Status	Date of clinical signs noted	Treatment	Outcome
DSR	996742	4.5ys	I	< 8/3	N	Flagged by AA but not checked by a vet, reclaimed on August 5th.
DSR	950651	4.5ys	E	N/A	N	No clinical signs developed.
DSR	996741	4.5ys	E	N/A	N	Reclaimed on August 5th.
DSO	996484	4.2ys	I	8/1	T	8/1: Doxycycline 10mg/kg PO q24h for 7 days, resolved.
DSO	996828	4ys	I	< 8/3	N	Flagged by AA but not checked by a vet, euthanised on August 7th due to behavioral concerns.
DSO	995732	5.8ys	I	< 8/3	N	Flagged by AA but not checked by a vet, has had ocular discharge on July 25th. Treated and resolved.
DSO	997905	7.5ys		8/3	T	8/3: Meloxicam 0.1mg/kg PO q24h for 7 days. PCR swab (result returned on 8/9): CPnV and M.cynos, 8/9: Doxycycline 10mg/kg PO q24h for 10 days 8/13: Codeine 1mg/kg PO q12h for 5 days.

			I			8/19: completed all medications, but still had a honking cough, isolated for further 5 days without medications. 8/25: Cough resolved.
DSO	996618	2.4ys	I	7/31	T	7/31: Doxycycline 10mg/kg PO q24h for 10 days, meloxicam 0.1mg/kg PO q24h for 7 days, resolved.
DSO	989613	6.9ys	E	N/A	N	No clinical signs developed.
DSY	996185	2.6ys	I	< 8/3	N	Flagged by AA but not checked by a vet.
DSY	994469	10ms	I	8/3	N	8/3: examined, no treatment required.
DSY	995603	14.2ys	I	7/31	T	7/31: Doxycycline 10mg/kg PO q24h for 7 days; meloxicam 0.1mg/kg PO q24h for 7 days, resolved.
DSY	996222	4ms	I	8/1	T	8/1: Doxycycline 10mg/kg PO q24h for 7 days, resolved.
DSY	996228	4ms	I	8/1	N	8/1: Examined, no treatment required.
DSY	996645	14.6ys	I	8/3	T	8/3: Doxycycline 10mg/kg PO q24h for 7 days, resolved.
DSY	994468	10ms	E	N/A	N	No clinical signs developed.
DSY	996196	1.3ys	E	N/A	N	No clinical signs developed.
DSY	996183	1.3ys	E	N/A	N	No clinical signs developed.
DSY	995666	6ms	E	N/A	N	No clinical signs developed
DSB	996351	2.1ys	I	7/31	T	7/31: Doxycycline 10mg/kg PO q24h for 10 days, meloxicam 0.1mg/kg PO q24h for 7 days. 8/6: Doxycycline was extended for 5 more days, resolved.
DSB	996766	3.9ys	I	7/31	T	7/31: Doxycycline 10mg/kg PO q24h for 10 days; meloxicam 0.1mg/kg PO q24h for 7 days, resolved
Clinic	996515	8.5ms	I	8/3	T	8/3: Maropitant 1mg/kg IV q24h, amoxicllin 22 mg/kg

						IV q12h, Buprenorphine 0.02 mg/kg IV q8h. 8/6: Doxycycline 10 mg/kg PO q24h for 10 days, resolved.
DSB	995604	1.4ys	I	8/3	N	8/3: Examined, no treatment required. PCR negative.
DSB	997889	1.4ys	I	8/3	N	8/3: Examined, no treatment required. PCR negative.
DSB	995342	3.1ys	I	<8/3	N	Flagged by AA but not checked by a vet
DSB	996363	2.1ys	I	7/28	T	7/28: Doxycycline 5mg/kg PO q12h for 7 days, resolved.
DSB	996353	2.1ys	I	8/3	N	8/3: examined, no treatment required. PCR negative.
DSB	996689	3.9ys	E	N/A		No clinical signs developed.
DSB	996479	1.1ys	E	N/A		No clinical signs developed.
DSB	996416	9.9ys	E	N/A		No clinical signs developed.
DSB	983430	2.2ys	E	N/A		No clinical signs developed.
DSB	996830	1.1ys	E	N/A		No clinical signs developed.
DSB	996356	2.1ys	E	N/A		No clinical signs developed.
ADOPTION	996224	4ms	I	8/3	N	8/3: Examined, no treatment required.
ADOPTION	996553	3.3ys	I	8/3	T	8/5: Doxycycline 5mg/kg PO q12h for 7 days, resolved.
ADOPTION	996511	3.8ys	I	8/3	N	8/3: Examined, no treatment required.
ADOPTION	996102	1.2ys	I	8/3	N	8/3: Examined, no treatment required.
ADOPTION	997947	4ms	I	8/3	T	8/7 - Doxycycline 5mg/kg PO q12h for 7 days, resolved.

USB	997992	7.3ys	I		T	8/1 – Doxycycline10mg/kg PO q24h for 7 days. 8/8: Extended doxycycline for another 7 days, resolved.
USB	986727	11.9ys	E	N/A		No clinical signs developed.
USB	998000	8ys	I	8/6	N	8/6: Examined, no treatment required.
USB	997974	5.1ys	I	8/4	N	8/6: Examined, no treatment required.
USB	994325	7.1ys	I	8/4	T	8/6: Doxycycline 5mg/kg PO q12h for 7 days, resolved.
USG	996597	1.2ys	I	8/4	T	8/10: Doxycycline 5mg/kg PO q12h for 7 days, resolved. Kennel cough booster vaccine was given on the same date.
USG	996364	1.1ys	I	8/4	T	8/6: Doxycycline 5mg/kg PO q12h for 7 days, resolved.
USG	996368	2.1ys	I	8/4	N	8/6: Examined, no treatment required.
USR	996396	4ms	I	8/4	T	8/10 – Doxycycline 5mg/kg PO q12h for 7 days, resolved.
USY	995714	4.1ys	I	8/4	T	8/6: Doxycycline 5mg/kg PO q12h for 7 days, resolved.

Hospitalized
PCR collected

Figures 1, Thoracic radiograph of 996515 on August 2nd, 2023.

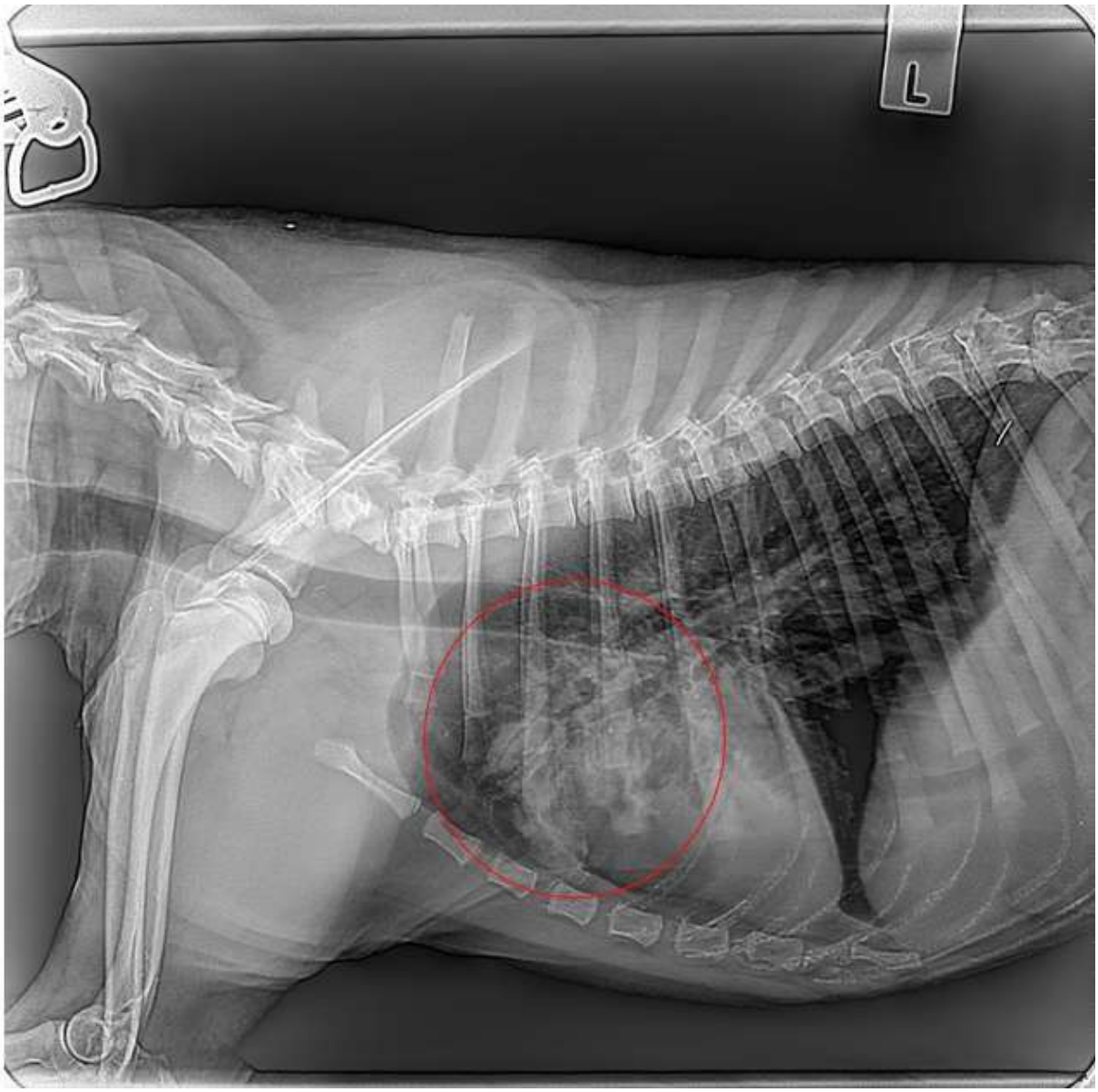

Figure 1. Left lateral chest radiograph of 996515; red circle indicated the patchy alveolar pattern in the cranioventral lung field.