Radiography — the reading roster

READ — ONE ROSTER, EVERY STUDY

R · Reject or accept
technique, positioning, exposure, phase of respiration, labels

E · Edges first
bones, body wall, skin, corners of the film (extra-cavitary)

A · Anatomy in order
same organ sequence every time — never 'look for the lesion'

D · Describe, then decide
opacity · size · shape · margin · number · location · distribution

FIVE OPACITIES (DARK → BRIGHT)

1 Gas black
2 Fat dark grey
3 Soft tissue = fluid mid grey (blood, urine, muscle, tumour all alike)
4 Mineral / bone light grey–white
5 Metal pure white

Silhouette sign: same-opacity structures in CONTACT lose their border. Summation: two overlapping objects fake a 'nodule' — check the second view.

THORAX ORDER

1 Trachea & carina → 2 Cranial mediastinum & oesophagus → 3 Cardiac silhouette (VHS, chambers) → 4 Pulmonary vessels (artery = vein; ≤ 9th rib width / ≤ 4th rib at the 4th rib) → 5 Lung by lobe (alveolar · interstitial · bronchial · vascular) → 6 Pleura, diaphragm, extra-thoracic

Lung patterns Alveolar = air bronchograms/lobar consolidation (cranioventral → aspiration/bronchopneumonia; caudodorsal → non-cardiogenic oedema/haemorrhage; perihilar → cardiogenic oedema, dog) · Interstitial unstructured = hazy, vessels blurred (early oedema, fibrosis, lymphoma, EXPIRATION) · Nodular = mets OR fungal/septic granulomas (soft-tissue opacity; osteomas are mineral; solitary ≠ primary) · Bronchial = donuts & tram-lines · Vascular = arteries (heartworm) / veins (L-CHF)

Pleural Effusion: fissure lines, lung retraction, effaced heart/diaphragm. Pneumothorax: pleural line with NO vessels beyond it (heart-off-sternum is supportive only).

ABDOMEN ORDER + KEY NUMBERS

1 Serosal detail (fat vs fluid/peritonitis) → 2 Liver, spleen, kidneys → 3 Stomach, SI, colon → 4 Bladder, prostate/uterus → 5 Retroperitoneum, nodes, vessels → 6 Spine, pelvis, body wall

Kidney (VD) dog 2.5–3.5 × L2 · cat 2.4–3.0 × L2 (older/neutered 1.9–2.6) **SI diameter** dog < 1.6 × L5 height · cat < 12 mm **Obstruction** two populations of bowel · gravel sign · plication + comma gas (linear FB) **GDV** compartmentalised gas-filled stomach, pylorus dorsal on RIGHT lateral

Stones struvite/CaOx opaque · urate LUCENT, cystine faintly opaque (ultrasound sees all) **Pregnancy** fetal skeletons from day 42–45; count skulls; fetal death = intrafetal gas, Spalding sign

Pyometra coiled tubular soft-tissue opacity between colon and bladder, no skeletons

Bone — aggressive vs benign zone of transition (long/indistinct vs short/sharp) · cortex destroyed vs intact · periosteal reaction irregular/sunburst/Codman vs smooth solid · soft-tissue mass · rapid change

Hips dorsal rim coverage > 50 % · Norberg angle ≥ 105° · reject rotated films (unequal obturator foramina)

Cardiac numbers — VHS, VLAS, echo, ACVIM

VERTEBRAL HEART SCORE (BUCHANAN & BÜCHELER 1995)

Right lateral. Long axis: carina → apex. Short axis: perpendicular at the widest point. Transfer both from the CRANIAL edge of T4; sum in vertebrae to 0.1 v.

General dog 8.5–10.5 v (mean 9.7 ± 0.5) · Cat 7.5 ± 0.3 v (Litster & Buchanan 2000)

VLAS (Malcolm 2018): carina → caudal LA border from T4. ≤ 2.3 normal · > 2.3 suggests LA enlargement · ≥ 3.0 strongly supports.

BREED-SPECIFIC VHS (RIGHT LATERAL, 95 % RANGES — LAMB 2001; JEPSEN-GRANT 2013 ET AL.)

BREED	VHS	BREED	VHS
Boxer	10.8 – 12.4	Pug	9.8 – 11.6
Bulldog (Eng/Fr)	11.0 – 14.4	Pomeranian	9.6 – 11.4
Boston Terrier	10.3 – 13.1	Whippet	10.5 – 11.8
Cavalier KCS	10.1 – 11.1 (mean 10.6)	German Shepherd	8.5 – 10.5
Labrador	10.2 – 11.4	Norwich Terrier	10.0 – 11.2
Dachshund / mixed	use general 8.5 – 10.5	Yorkshire (VLAS)	≤ 2.4

ACVIM 2019 — MMVD STAGE B2 (KEENE ET AL.) → START PIMOBENDAN

All of: murmur ≥ 3/6 · LA:Ao ≥ 1.6 (RPS short axis, early diastole) · LVIDDN ≥ 1.7 · breed-adjusted VHS > 10.5

LVIDDN = LVIDd (cm) ÷ BW (kg)^0.294 (Cornell 2004)

Radiograph-only surrogate (no echo available): VHS ≥ 11.5 AND VLAS ≥ 3.0, or a VHS rise ≥ 0.5 v over 6 months.

B1 = MMVD without remodelling meeting these criteria (monitor) · C = current/past CHF · D = refractory CHF.

DOG ECHO

LA:Ao < 1.5 normal · ≥ 1.6 enlarged

FS ≈ 25–45 % (Boxer, Dobermann lower)

FS = (LVIDd – LVIDs) / LVIDd

Chamber pattern (lateral): LA ↑ = LEFT MAIN-STEM BRONCHUS lifted at the carina, caudal waist lost (VLAS > 2.3) · LV = tall heart, straight caudal border · RV = ↑ sternal contact, reverse-D on VD · global = pericardial effusion, DCM, expiration

DCM: thin globular LV, FS < 20 %, LA ↑. MMVD: thick club leaflets, prolapse, MR jet. Pericardial effusion: anechoic rim — scan R auricle & heart base before draining.

CAT ECHO — ACVIM 2020 (LUIS FUENTES)

LV wall (end-diastole) < 5 mm normal · 5–6 mm equivocal (re-check) · ≥ 6 mm hypertrophy (HCM phenotype)

Measure 2D in ≥ 2 RPS views, thickest septum & free wall, EXCLUDE papillary muscles; M-mode and 2D not interchangeable.

LA:Ao < 1.5 normal · > 1.8, LA ≥ 16 mm, LA FS < 12 %, LAA velocity < 0.25 m/s = CHF/ATE risk → stage B2 → clopidogrel

Spontaneous echo contrast ('smoke') = stasis → thrombus risk.

Cat VHS 7.5 ± 0.3; 'valentine' heart on VD is a late sign — echo earns its keep.

CT & MRI decoder

HOUNSFIELD LADDER (WATER = 0 BY DEFINITION)

TISSUE	HU
Air / gas	–1000
Lung	–900 … –500
Fat	–120 … –80
Water / simple fluid	0 (± 10)
CSF, urine, transudate	0 … +15
Soft tissue / muscle	+30 … +70
Acute clot	+50 … +90
Enhancing tissue	+80 … +200+
Mineral / cancellous	+200 … +700
Cortical bone	+700 … +1500
Metal	> +2000 (streak)

WINDOWS & CONTRAST

Window maps an HU range onto visible greys (width = range, level = centre). Read every study in ≥ 3 windows.
Bone W 2000 / L 500 **Lung** W 1500 / L –600
Soft tissue W 400 / L 40 **Brain** W 80 / L 40 **Liver** W 150 / L 70
ROI habit: pre & post contrast on every mass/fluid. Enhancement > +20 HU significant; +100 = marked (hypervascular).
Phases: arterial 15–25 s (arteries, shunts, bleeding) · portal 60–90 s (parenchyma, masses, nodes) · delayed 3–10 min (ureters, fibrous, washout).
MPR kills superimposition; 3D renders are for shape only (thresholds hide lysis).

MRI SEQUENCE GRID

SEQUENCE	BRIGHT	DARK	USE FOR
T1W	fat, gadolinium, subacute blood, protein	water/CSF, oedema, bone, gas	anatomy, enhancement
T2W	water, CSF, oedema, most lesions, fat	cortical bone, gas, haemosiderin	lesion detection, discs, cord
FLAIR	oedema/lesions (CSF nulled)	CSF	periventricular, brain
STIR	fluid/oedema (fat nulled)	fat	spine, marrow, muscle
T2* (GRE)	—	blood products, mineral, gas (bloom)	haemorrhage
DWI / ADC	restricted diffusion	—	infarct, abscess
T1 + Gd	barrier breakdown / vascular	—	tumour, inflammation, meninges

Two-question decoder: CSF bright? → T2 (yes) / T1, FLAIR (no). Fat bright? → T1, T2 (yes) / STIR, fat-sat (no).

BRAIN — FOUR QUESTIONS

1 Symmetric? bilateral symmetric = metabolic / toxic / nutritional / degenerative (hepatic encephalopathy, thiamine, osmotic demyelination) · asymmetric = tumour, infarct, abscess
2 Where? grey vs white matter, nuclei, ventricles, meninges
3 Mass effect? midline shift, herniation = urgency
4 Enhancement? ring (abscess, necrotic tumour) · homogeneous + dural tail extra-axial = meningioma · meningeal = inflammation
Ageing brain: ventriculomegaly, wide sulci, thin interthalamic adhesion, T2* microbleeds.

SPINE — PROTOCOL & VOCABULARY

Sagittal T2 + STIR (screen) → transverse T2 at EVERY abnormal level → T1 pre/post if infection/neoplasia → dorsal STIR for roots.
Disc: bright & tall = healthy · dark & narrow = degenerate · bright line in dark annulus = fissure (HIZ).
Compression: CSF ring effaced, cord deformed on transverse. Quantify with cord cross-sectional ratio vs normal level.
Location: extradural (disc, tumour, haemorrhage) · intradural-extramedullary (nerve-sheath tumour, meningioma; 'golf-tee') · intramedullary (glioma, myelitis, infarct).
Signal void in fluid = gas or blood (T2* confirms).

Ultrasound — artefacts, organ numbers, FAST

PROBE & ARTEFACTS

Micro-convex 5–8 MHz abdomen · **Linear 10–18** GI wall, adrenals (cat), neck, tendons · **Phased 3–7** heart. Highest frequency that reaches the depth.
Clean shadow = mineral · **dirty/reverberating shadow** = gas · **enhancement** behind fluid · **comet tail** = gas/metal (needles, catheters) · **twinkle** (colour Doppler) = rough mineral = stone · **mirror** = liver across the diaphragm (normal).
Echogenicity is RELATIVE: compare liver vs spleen vs renal cortex at the same depth and gain.

LIVER · GALLBLADDER · SPLEEN

Liver grades 0–3: vs spleen at same depth; grade 3 = brighter than spleen, deep attenuation, vessel walls lost (vacuolar hepatopathy, lipidosis, fibrosis, lymphoma). Diffuse vs focal is the US job; cytology names it.
GB: sludge = gravity-dependent, moves · mucocele = immobile stellate 'kiwi', thick wall, rupture risk · wall mass with DOPPLER FLOW = neoplasia · stone = shadow + twinkle.
Spleen: nodules cannot be classified by US (HSA vs hyperplasia) — say so. Mass + free fluid + collapse = haemoabdomen.

KIDNEY · ADRENAL · BLADDER

Kidney cat 3.0–4.3 cm · dog kidney-length : aortic-diameter 5.5–9.1 (< 5.5 small, > 9.1 large) · pelvis < 2 mm · proximal ureter ≤ 1.8 mm. Read: size, cortex echogenicity, CMD, pelvis, infarcts, mineral.
Adrenal caudal pole dog < 10 kg ≤ ~5.4 mm · 10–30 kg ≤ ~6.8 · > 30 kg ≤ ~8.0 (Soulsby 2015, Bento 2016) · cat ≤ ~4.3–4.8 (Combes). Left = peanut cranio-medial to L kidney at the phrenicoabdominal vein; right = arrow-head against the CVC (intercostal window).
Bilateral symmetric plump = PDH · one large + one atrophied = adrenal tumour · check CVC / phrenicoabdominal vein invasion. US never diagnoses Cushing's — endocrine tests do.
Bladder: sediment shifts with gravity; masses don't. Scan the WHOLE urethra (os penis stones hide from films).

GI WALL · PANCREAS · REPRO

Five layers (lumen → out): mucosal surface (bright) · mucosa (dark) · submucosa (bright) · muscularis (dark) · serosa (bright).
Upper limits (mm): dog stomach 5 · duodenum 5 (large dogs 6) · jejunum 4.1 (> 20 kg 4.7) · colon 2–3. Cat stomach 4.4 (interrugal 2) · duodenum/jejunum 2.5 · colon 1.7 · muscularis > submucosa (■ 1 mm) = IBD vs lymphoma → sample.
Layering LOST + thick → sample (neoplasia vs severe inflammation). Preserved layering + thick muscularis in cats = IBD OR lymphoma — histology decides. Two loop populations = obstruction; target sign = intussusception.
Pancreas: R lobe along duodenum, L lobe caudal to stomach; pancreatitis = enlarged, hypoechoic, bright fat, ± fluid. Normal scan does NOT exclude it.
Pyometra: fluid-filled convoluted horns between bladder and colon, no fetal structures.

POINT-OF-CARE: AFAST · TFAST · VET BLUE (LISCIANDRO)

AFAST diaphragmatico-hepatic · spleno-renal · cysto-colic · hepato-renal → abdominal fluid score 0–4. **TFAST** chest-tube site (pneumothorax: no glide sign), pericardial site (effusion, LA:Ao), pleural fluid.
Vet BLUE — 4 regions bilateral, gator-sign orientation: caudodorsal (8–9 ICS, upper third) · perihilar (6–7, middle) · middle (4–5, lower) · cranial (2–3, lower; extend foreleg) + DH view.
Signs: dry lung = A-lines + glide · wet lung = B-lines (count 0 / 1 / 2 / 3 / > 3 / ∞) · shred = aerated consolidation · tissue = hepatisation · nodule · wedge = PTE.
Patterns: all dry → rules out L-CHF (asthma, upper airway, PTE) · wet dorsal + perihilar bilateral → cardiogenic oedema · wet dorsal only → non-cardiogenic oedema · wet ventral ± shred/tissue → pneumonia · multiple nodules → mets / granulomas.
Echo quick: LA:Ao < 1.5 · FS 25–45 % · pericardial effusion: scan R auricle & heart base before draining.

C.R.A.F.T. report + positioning checklist

C.R.A.F.T. — THE REPORT SKELETON

C · Criteria study, views/sequences, technical adequacy, limitations ('DV mildly rotated', 'porta not visualised')
R · Ratios & numbers VHS, VLAS, LA:Ao, LVIDDN, kidney × L2, HU, wall thickness, adrenal mm — every number you measured earns a line
A · Architecture region-by-region findings with standard descriptors: opacity/echogenicity/attenuation/intensity · size · shape · margin · number · location · distribution
F · Findings summary one to three prioritised lines
T · Take-home ranked differentials + the next step (echo / sample / CT / recheck in N days)
Normal report = 3 lines: views & adequacy · normal by region · no abnormality, clinical correlation. Describe before you diagnose: '3 cm well-defined soft-tissue nodule, right caudal lobe' is a finding; 'tumour' is a guess.

POSITIONING & QC CHECKLIST (WSAVA TECHNIQUE NOTES)

Thorax lateral forelimbs pulled cranially, centre on heart, collimate point of shoulder → 13th rib; INSPIRATORY; ribs superimposed; no lung dorsal to spine. Both laterals + VD/DV for metastasis screening. **VD** sternum over spine, spinous processes tear-drop centred. **DV** for the dyspnoeic patient.
Abdomen lateral hind limbs caudally, centre 13th rib, 6th rib → hips, transverse processes superimposed, time ≤ 1/30 s, high contrast. RIGHT lateral for GDV, LEFT lateral to gas-float a gastric FB. **VD** limbs relaxed, spinous processes centred.
Skull hard palate parallel to table (sponge under nose; 45° wedge brachycephalic/cat), mandibular rami superimposed; DV rami flat; obliques 20–30° for arcades/bullae; rostrocaudal open-mouth for bullae (GA). **Spine** parallel to cassette (pad neck, sternum, lumbar); 5–7 vertebrae per film; sedate.
Limbs two orthogonal views, joints above and below; views named beam entry → exit (DLPaMO). Elbow: flexed lateral (anconeal) + 15° pronated CrCd (coronoid). Stifle: skyline for patella. **Hips** extended VD under sedation: femurs parallel, patellae centred, obturator foramina symmetrical — reject rotation.
Exposure kV = contrast/penetration, mAs = density; measure thickest part; grid > 10–12 cm (×2–3 mAs); thorax high kV/low mAs, abdomen & bone lower kV/higher mAs. Digital: read the exposure index — quantum mottle = under, burnt-out edges = over; beware dose creep; collimate tightly for the histogram.
Artefacts motion · grid cut-off · skin fold (line continues beyond the wall) · nipples/end-on vessels (one view only) · wet hair/collar/tape · Uberschwinger halo · dead pixels · double exposure · costochondral mineralisation · sandbag edge.
Radiation distance (inverse square) · collimate · NO hands in the beam — sedate, sandbag, tape · lead worn, dosimeter worn · pregnant staff out.

MODALITY CHOICE — ASK 'WILL THE RESULT CHANGE WHAT I DO?'

Acute abdomen → films (2–3 views) then US · Cough + murmur → films then echo · Epistaxis/nasal discharge → CT (turbinates, cribriform plate, orbit) · Back pain/paresis → films (fracture, discospondylitis) then MRI · Adult-onset seizures → bloods then MRI ± CSF · Lameness → films, then CT (complex joints) / MRI (marrow, soft tissue) · Bulging eye → orbital US then CT/MRI.
Bone, lung, mineral, gas → radiographs/CT. Cord, brain, disc, soft-tissue contrast → MRI. Fluid, moving organs, guided sampling, no radiation → ultrasound. Grey-scale rule: fat is BRIGHT on US and T1, DARK (–100 HU) on CT and STIR.