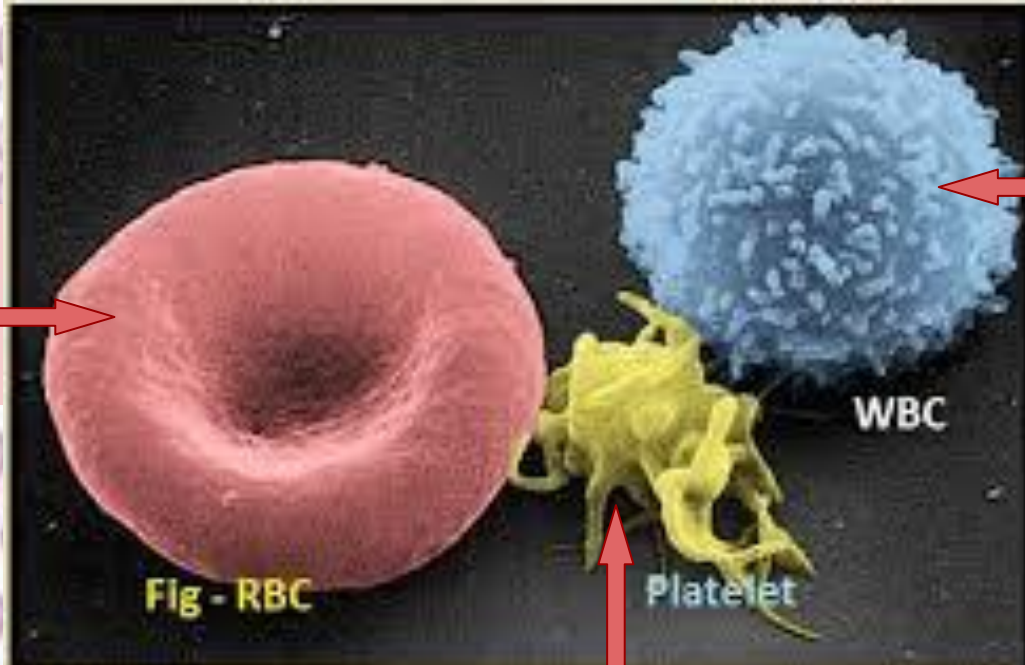


Labwork Results - What Does It All Mean?

Understanding CBCs, Chemistry Panels, Urinalyses, and more

Blood Cells

Red Blood Cell
= Erythrocyte



White Blood Cell
= Leukocyte

Platelet = Thrombocyte

CBC (Complete Blood Count)

1. RBC - Red Blood Cells

- a. These are the cells that have hemoglobin proteins which:
 - i. Carry and deliver oxygen (O_2) throughout the body
 - ii. Carry carbon dioxide (CO_2) from the tissues to the lungs to be exhaled
- b. Low RBC values indicate **anemia**, which can be due to a variety of causes
- c. High RBC values *can* indicate **dehydration**, or possibly overproduction of RBCs
- d. This value shows the **number of RBCs** present per set volume of blood

2. HCT - Hematocrit

- a. This value is a percent; the **percent of RBCs** in the blood
- b. Normal ranges are typically between 30% - 50% but have some species differences

3. HGB - Hemoglobin

- a. This is the protein in RBCs that carry O_2 and CO_2 to and from tissues
- b. This value represents the **amount of hemoglobin** present per unit of blood

Most of the time, these three values are correlated.

CBC Results

4. MCV - Mean Corpuscular Volume
 - a. This value indicates the **average size of the RBCs**
 - b. Can be affected by anemias, breed, mineral/vitamin deficiencies, artifact, liver disease, age
5. MCH - Mean Corpuscular Hemoglobin
 - a. This value gives the **average weight of hemoglobin** in the RBCs
 - b. Can be affected by hemolysis, hemorrhage, or iron deficiency, sample or artifact errors
6. MCHC - Mean Corpuscular Hemoglobin Concentration
 - a. The **calculated amount of hemoglobin** in a specific volume of RBCs (MCH-to-MCV ratio)
 - b. More reliable than MCH, this corrects for variations in cell size/volume
7. RDW - Red Blood Cell Distribution Width
 - a. A measurement of the **degree of size variation of RBCs**
 - b. An increased value means there is more variation in cell size
 - c. Size variation is abnormal - RBCs are usually fairly uniform in size and shape

CBC Results

- 8. — %RETIC - This value is the **% of RBCs are reticulocytes** (number of reticulocytes ÷ total RBCs)
- 9. RETIC - Reticulocytes are immature RBCs
 - a. This value is the **number of reticulocytes** in the blood
 - b. They are often seen in **regenerative anemia**
- 10. WBC - White Blood Cells
 - a. These are the blood cells that make up the immune system
 - b. Different types have different roles and functions
 - i. Fight bacterial or viral infections, attack pathogens
 - ii. Role in inflammation
 - iii. Allergic reactions
 - iv. Protect against parasites
 - v. Innate (immediate, non-specific) and adaptive (requires exposure, targeted) immunity
 - c. This value is the **total number of WBCs** in the blood
 - i. High values *can* indicate infection/inflammation, bone marrow issues, medication effect
 - ii. Low values *can* indicate immune system issues, infection, bone marrow issues, cancer, medication effect

CBC Results

11. %NEU - Percent of WBCs that are neutrophils

a. calculated by this formula \Rightarrow (number of neutrophils \div total WBCs = % neutrophils)

12. %LYM - Percent of WBCs that are lymphocytes

13. %MONO - Percent of WBCs that are monocytes

14. %EOS - Percent of WBCs that are eosinophils

15. %BASO - Percent of WBCs that are basophils

Combined, these will all add up to 100% (= all the WBCs that the patient has)

16. NEU - Number of WBCs that are neutrophils

17. BAND - Number of WBCs that are bands (immature neutrophils)

18. LYM - Number of WBCs that are lymphocytes

19. MONO - Number of WBCs that are monocytes

20. EOS - Number of WBCs that are eosinophils

21. BASO - Number of WBCs that are basophils

Combined, these will add up to the total number of WBCs that a patient has

CBC Results

22. PLT - Platelets

- a. Platelets originate from cells in the bone marrow and are responsible for blood clotting
- b. This value is the **number of platelets** in the blood

23. MPV - Mean Platelet Volume

- a. This value indicates the **average size of the platelets** that are in the blood
- b. Newer/younger platelets are larger, older platelets are smaller
- c. This value can give information about platelet formation and production in the bone marrow

24. PDW - Platelet Distribution Width

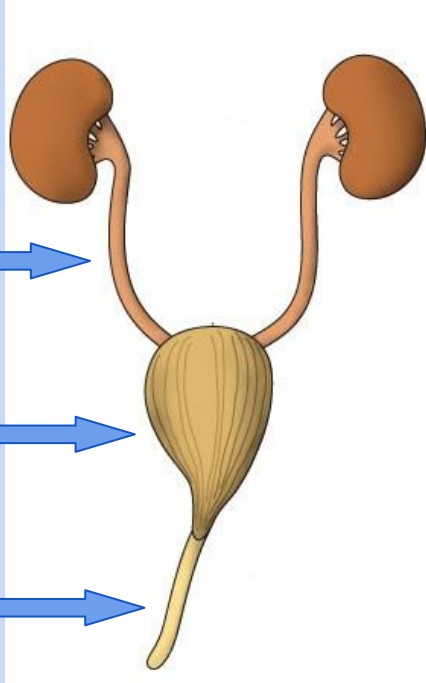
- a. This value reflects **variability in platelet size**
- b. Variability can indicate any number of disease processes, cancer, or other conditions

25. PCT - Plateletcrit

- a. Represents what **percentage of the blood that is platelets**
- b. This is normally very small (< 1%,) but abnormalities can suggest bone marrow problems, or could be due to medication side effects

Renal = Kidney

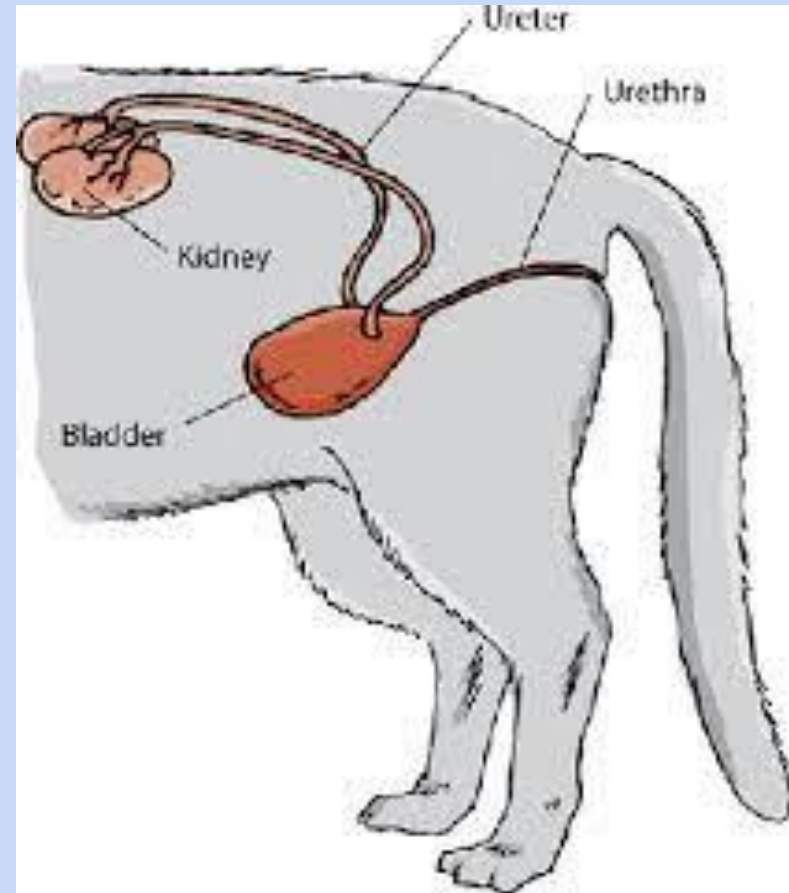
Kidney →



Ureter →

Bladder →

Urethra →



Renal (Kidney) Panel

1. CREA - Creatinine

- a. Creatine is used as an energy source for muscles. As it is metabolized, Creatinine is created as a waste product. Normally, the **kidneys remove Creatinine from the body and excrete it through urine**. If the kidneys are not functioning well, the levels of Creatinine in the blood will increase.

2. BUN - Blood Urea Nitrogen

- a. Ammonia, which contains nitrogen, is created by the liver as it breaks down proteins. That nitrogen combines with other chemical elements to form the waste product urea. **Urea is filtered by the kidneys and excreted in urine**. If the kidneys are not working properly, BUN levels will increase.

Azotemia is the term to describe increased BUN and Creatinine in the blood.

3. BUN/CREA - BUN-to-Creatinine ratio

4. PHOS - Phosphate/Phosphorus

- a. Phosphorus from food combines with oxygen in the bloodstream to create phosphate compounds. Phosphates and Calcium work together to build and repair bones and teeth, as well as support muscles and nerves. The **kidneys filter out excess phosphates from the bloodstream**. If the kidneys are not functioning well, Phosphate levels will increase.

Renal (Kidney) Panel

5. ALB - Albumin

- a. **Albumin is a protein** made by the liver. It **helps in maintaining fluid in the bloodstream** and carries hormones, vitamins, and enzymes. If the kidneys are not reabsorbing fluids effectively, there is increased fluid loss through urine excretions, and Albumin levels will be decreased.

6. NA - Sodium

- a. **Electrolyte** that controls amount of fluid in body, and helps muscles and nerves function.
- b. Renal failure or poorly functioning kidneys can result in decreased Na levels.

7. K - Potassium

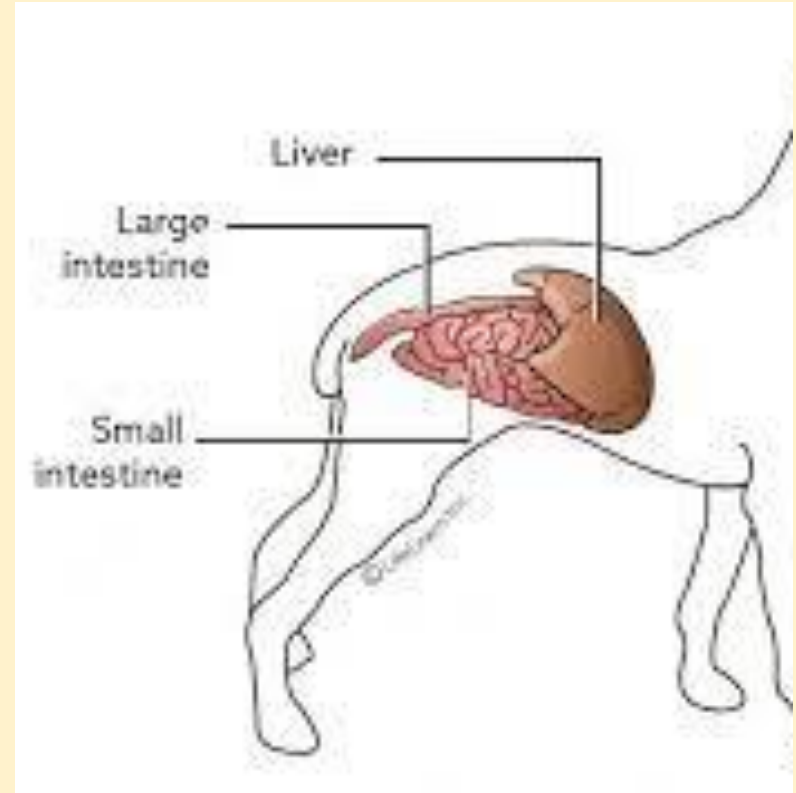
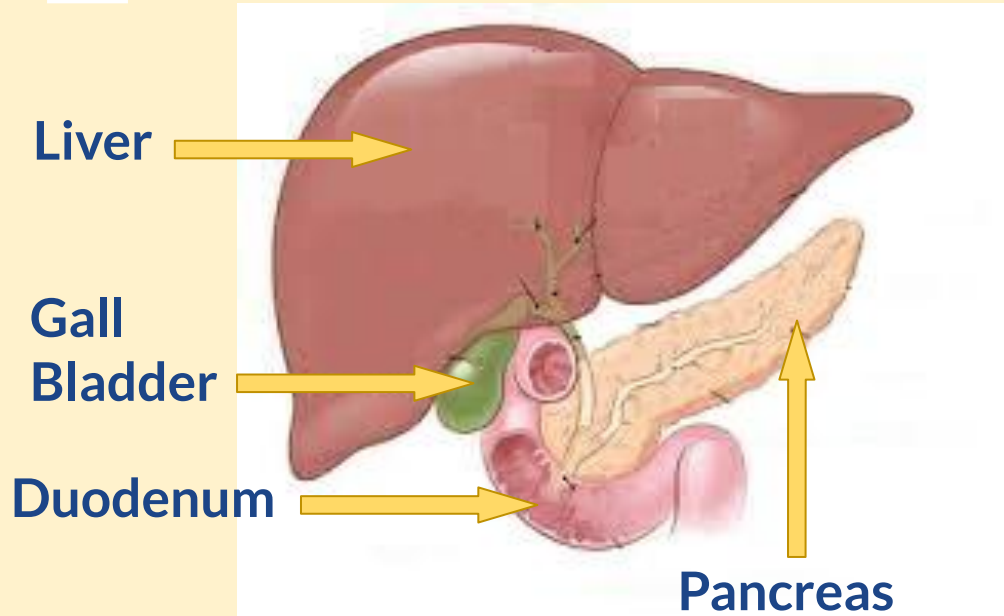
- a. **Electrolyte** that helps heart, nerves, and muscles work properly.
- b. Chronic kidney disease can cause decreased K levels.

8. NA/K - Sodium-to-Potassium ratio

9. CL - Chloride

- a. **Electrolyte** that controls amount of fluid in body, & helps maintain blood volume & blood pressure
- b. Chronic kidney disease can cause elevated Cl levels.

Liver = Hepato-



Liver Panel

1. GLU - Glucose
 - a. **Glucose is a sugar** used for energy. The liver breaks down glycogen into glucose, and also builds glucose from amino acids. In some cases of hepatic dysfunction, glucose levels may be decreased.
2. ALB - Albumin
 - a. **Albumin is a protein** made by the liver. It **helps maintain fluid in the bloodstream**. If the liver is not functioning properly, it may not produce enough Albumin, so Alb levels will be decreased.
3. ALT - Alanine Transaminase, Alanine Aminotransferase
 - a. **ALT is an enzyme** found mostly in the liver that is **involved in normal liver functions**. When liver cells are damaged, ALT is released into the bloodstream. A high ALT suggests a liver issue.
4. ALKP - Alkaline Phosphatase
 - a. **AlkP is an enzyme** found in the liver (also in bones, kidneys, intestines) **involved in many metabolic functions**. Elevations can indicate liver damage or blockage (of the bile duct/gallbladder).
5. TBIL - Total Bilirubin
 - a. **Bilirubin is one of the breakdown products of hemoglobin** (O₂ carrying protein in RBCs). Bilirubin is processed in the liver and released as a component of bile into the intestines. Increases in bilirubin in the blood can indicate liver issues, and this accumulation in tissues causes **icterus** (jaundice).

Chem 15 Panel

LIVER PANEL value - see liver for more info
RENAL PANEL value - see renal for more info

1. **GLU** - **Glucose is a sugar** used for energy.
2. **CREA** - **Creatinine is a waste byproduct** of metabolized Creatine.
3. **BUN** - **Blood Urea Nitrogen is a waste product** of nitrogen compounds from protein breakdown.
4. **BUN/CREA** - Ratio of BUN value : Creatinine value.
5. **PHOS** - **Phosphate compounds help support bones & teeth**; kidneys filter excess from the blood.
6. **CA** - Calcium
 - a. **Calcium is a mineral** that plays a role in muscle contractions, nerve impulses, heart rhythm, blood clotting, and bone growth.
 - b. Its levels are regulated by the parathyroid gland. Increases or decreases in blood Calcium can impact many organ systems and point to various potential diseases.
7. **TP** - Total Protein
 - a. **Total Protein levels** include Albumin and Globulin.
 - b. Increases can indicate dehydration or inflammation; decreases can be seen with loss of blood, or with liver, kidney, or GI issues.
8. **ALB** - **Albumin is a protein** made by the liver that helps maintain fluid in the bloodstream.

Chem 15 Panel

LIVER PANEL value - see liver for more info
RENAL PANEL value - see renal for more info

9. **GLOB** - Globulins
 - a. **Globulins are proteins** made in the liver and by WBCs. They help with liver function, blood clotting, and fighting infection, osmotic balance, and inflammatory responses.
10. **ALB/GLOB** - Ratio of Alb value : Glob value.
11. **ALT** - **ALT is an enzyme** found mostly in the liver.
12. **ALKP** - **AlkP is an enzyme** found in the liver and elsewhere in the body.
13. **GGT** - Gamma Glutamyl Transferase
 - a. **GGT is an enzyme** that metabolizes a specific amino acid. It can indicate liver or biliary disease.
14. **TBILI** - **Bilirubin is one of the breakdown products of hemoglobin.**
15. **CHOL** - Cholesterol
 - a. **Cholesterol is a natural steroid**; levels can indicate liver function, GI disease, or metabolic disorder.
16. **NA** - **Sodium is an electrolyte.**
17. **K** - **Potassium is an electrolyte.**
18. **NA/K** - Ratio of NA value : K value.
19. **CL** - **Chloride is an electrolyte.**
20. **Osm Calc** - Calculated Osmolality
 - a. **Calc Osm the amount of dissolved particles in the blood**, (formula uses Na, K, Glu, and BUN values).

Chem 17 Panel

A Chem17 Panel includes all of the values from a Chem15 Panel, with the addition of the following:

1. LIP - Lipase

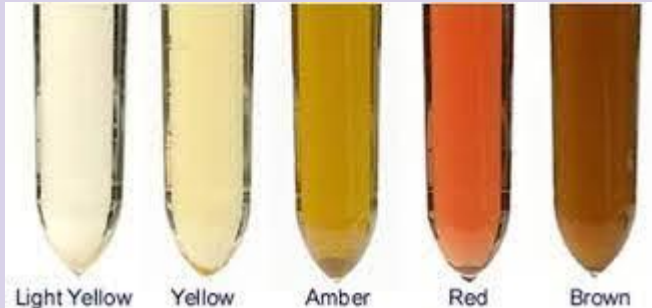
- a. **Lipase is an enzyme** that breaks down fat (lipids). It can help indicate pancreatic function, but is not the most sensitive test. Lipase levels fluctuate rapidly, and mild elevations can be due to a number of causes unrelated to the pancreas. Significant increases in Lipase ($\geq 3x$ normal) are more reliable than small increases.

2. AMYL - Amylase

- a. **Amylase is an enzyme released by the pancreas** that breaks down carbohydrates and starches. Elevated levels of this enzyme, especially when coupled with elevated Lipase levels can indicate pancreatic inflammation or disease.

Urinalysis Results

1. Collection Method - how was the sample obtained?
 - a. Free-catch / Voided - sample obtained mid-stream during urination
 - b. Cystocentesis - sterile sample obtained directly from bladder
 - c. Urinary catheter - sterile sample obtained via urinary catheter
 - d. Other - least preferable due to contamination, sample from litter box, cage, tabletop, other.
2. Color
 - a. Range from clear/colorless to shades of yellow, amber, red, brown



3. Clarity
 - a. Cloudiness of sample, or **turbidity** level

Urinalysis Results

4. SG - Specific Gravity
 - a. This is how dense, or concentrated, the urine is
 - b. Low SG can indicate poor kidney function, and high SG can indicate dehydration
5. pH - Acid-Base Scale
 - a. How acidic or basic urine is. Normal for cats is (6.3-6.6), normal for dogs is (7.0-7.5)
6. PRO - Protein
 - a. There is normally some protein in urine, especially if concentrated or dehydrated
 - b. If levels are low, may indicate kidney dysfunction (kidneys not concentrating urine well)
7. GLU - Glucose
 - a. This sugar is not normally present in healthy cat and dog urine
 - b. Often suggests diabetes, but can also indicate kidney function or other systemic disease
8. KET - Ketones
 - a. Waste byproduct when the body burns a lot of fat for energy
 - b. Often, its presence indicates diabetes, but can be seen in starvation/malnutrition
9. UBG - Urobilinogen - indicates liver function, can indicate anemia status

Urinalysis Results

10. BIL - Bilirubin
 - a. Can indicate liver function, biliary issues, or destruction of RBCs
11. BLD - Blood
 - a. Can be from urinary infections, bladder stones, trauma, cancer
 - b. Can be from sample collection - cystocentesis or catheterization may cause slight bleeding
12. Havoc Cox 1276609 - all the sedivue things

Urinalysis Results - Sedivue

1. WBC - White Blood Cells
2. RBC - Red Blood Cells
3. BACr - Bacteria: rods
4. BACc - Bacteria: cocci
5. sqEPI - Squamous Epithelial Cells
6. nsEPI -
7. HYA - Hyaline Casts
8. nhCST - Non-Hyaline Casts
9. CRY - Crystals
10. CaOxDi - Calcium Oxide
11. STR - Struvite Crystals
12. BIURAT -
13. BILI - Bilirubin

INCOMPLETE

Other Lab work Results - Blood Typing

1. Canine Blood Types

- a. DEA = Dog Erythrocyte Antigen
 - i. At least 8 DEA proteins have been identified
- b. DEA 1.1 NEGATIVE
 - i. These dogs do NOT have a particular antigen on their cells
 - ii. They can **ONLY** receive other DEA 1.1 NEGATIVE blood
- c. DEA 1.1 POSITIVE
 - i. These dogs DO have the DEA 1.1 antigen on their blood cells
 - ii. They can receive DEA 1.1 NEGATIVE **OR** DEA 1.1 POSITIVE blood

2. Feline Blood Types

- a. Type A - most common, more than 95% of cats in the U.S. are Type A
 - i. Type A cats can only receive Type A blood (and this is the only blood type AAVEC carries)
- b. Type B - quite rare (<5% in U.S.), some prevalence in certain breeds (Cornish and Devon Rexes, Turkish Vans, Turkish Angoras, British Shorthairs, and some other purebreds)
 - i. Type B cats can only receive Type B blood
- c. Type AB - extremely rare
 - i. Type AB cats can receive Type A or Type AB blood

Other Labwork Results - SNAP Tests

1. 4Dx Test

a. Heartworm (*Dirofilaria immitis*)

- i. Worms live in heart and in the pulmonary vessels, interfering with heart valve function and clogging blood vessels. This impacts circulation; can affect all organs (esp. lungs, liver, kidneys).
- ii. **Lifecycle:** Mosquito feeds on HW-infected animal, ingests microfilaria (baby worms) → microfilaria grow/mature in mosquito into infective larvae → mosquito feeds on new animal, infecting them with those larvae → larvae finish maturation and reproduction in new host.
- iii. The SNAP test tests for *Dirofilaria* **antigen**, so a positive result is diagnostic (but doesn't indicate parasite number/load). Treatment has some risks, but usually successful (95%). Preventatives to prevent infection or re-infection.

b. Lyme

- i. This tick-borne disease (*Borrelia* bacterium from the deer tick, black-legged tick) can cause lameness, joint swelling/pain, swollen lymph nodes, fever, fatigue, and anorexia. Severe kidney complications can also result. Present in the Midwest through eastern U.S. as well in as Canada.
- ii. The SNAP test detects **antibodies** to the *Borrelia* bacteria - therefore, positive results can occur even after a pet has been treated with antibiotics (prognosis is usually good, but poor if kidneys are affected). Vaccinations and monthly preventatives can protect against Lyme.

Other Labwork Results - SNAP Tests

c. Ehrlichia

- i. This tick-borne disease (*Ehrlichia* bacterium from the brown dog tick) can cause fever, swollen lymph nodes, respiratory distress, weight loss, bleeding disorders, and occasionally neurologic signs. It is prevalent in the southeastern and south central U.S.
- ii. The SNAP test detects **antibodies** to the *Ehrlichia* bacteria - therefore, positive results can occur even after a pet has been treated with antibiotics (prognosis is usually excellent in acute/early stage, but guarded in later/chronic stage).

d. Anaplasma

- i. This tick-borne disease (*Anaplasma* bacterium from deer tick, black-legged tick, brown dog tick) causes lameness, joint pain, fever, lethargy, and anorexia. It is endemic to the Mid-Atlantic area (~12% = + results)
- ii. The SNAP test detects **antibodies** to the *Anaplasma* bacteria - therefore, positive results can occur even after a pet has been treated with antibiotics (prognosis is usually excellent).

Other Labwork Results - SNAP Tests

1. FeLV/FIV Test

a. FeLV = Feline Leukemia Virus

- i. This is one of the most common infectious diseases in cats. It is spread through saliva, nasal secretions, urine, feces, and milk. It may cause immune deficiency, blood disorders, or cancer.
- ii. The SNAP test recognizes the presence of the antigen (actual virus/pathogen), so a positive result IS diagnostic. A vaccine does exist, but is not considered a core vaccination.

b. FIV = Feline Immunodeficiency Virus

- i. Usually transmitted through bite wounds, this infectious feline disease attacks the immune system. Many cats don't show symptoms in the latent period of the virus.
- ii. The SNAP test identifies antibodies in the blood; a positive result indicates that the cat is *likely* infected. *An FIV vaccine was discontinued in 2015, vaccinated cats had false positives.

2. Parvo Test

a. Canine Parvovirus (CPV)

- i. Highly contagious, very hardy virus that affects the GI

INCOMPLETE

Other Labwork Results

1. Cortisol

- a. SNAP test useful in determining adrenal function.
- b. Performing an ACTH stimulation test can help diagnose:
 - i. **Addison's Disease** (= **hypoadrenocorticism**) - the adrenal glands are not producing adequate amounts of cortisol and aldosterone (natural hormones).
 - ii. **Cushing's Disease** (= **hyperadrenocorticism**) - the adrenal glands secrete excessive cortisol.
 - iii. Need a baseline cortisol value ("pre"), then administration of Cortrosyn, a medication that stimulates the adrenal glands, and a comparison follow-up value ("post").

2. Bile Acids

- a. SNAP test useful in determining liver function.
 - i. Bile acids are released by the gallbladder to aid digestion. Once food is digested, the intestines absorb the bile acids, they enter the bloodstream, and are carried to the liver. The liver removes the bile acids from the blood and return them to the gallbladder for storage.
- b. Need a fasted sample (ideally 12-hour fast, "preprandial" = before eating), then a small meal is fed to the pet, and a comparison follow-up value ("postprandial" = after eating)

Other Labwork Results

1. T₄ (T₄)

- a. SNAP test that evaluates thyroid function
- b. **T₄ (=thyroxine) is the main hormone that is produced by thyroid**
 - i. Dogs tend to be **hypothyroid**; they have decreased T₄ production
 - ii. Cats tend to be **hyperthyroid**; they have increased T₄ production

2. SDMA

- a. Tests symmetric dimethylarginine - an amino acid that is a **sensitive indicator of kidney function**
- b. Can detect early losses in kidney function before onset of clinical signs and before other kidney values are affected

3. ProBNP

- a. **Cardiac function test**
- b. BNP = B-type Natriuretic Peptides, hormones which regulate intravascular volume and pressure
- c. Measures the number of concentration of BNP hormones released by the heart's muscle cells in response to stretch and stress
 - i. Higher values often indicate cardiac disorder or disease

Other Labwork Results

1. cPL, fPL - send out (pancreatic test)
2. Agglutination - RBC
3. Ears - Cytology
4. Fecals - Direct, Floats

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