Urinalysis

Urinalysis can provide insight into hydration status, renal function or dysfunction, systemic disease and toxic insults. It forms part of a baseline database in conjunction with a biochemical profile and CBC.

Species: All domestic species

Specimen: Urine

Container: Sterile containers are suitable for urinalysis, culture, cortisol and protein to creatinine ratios, fractional excretion studies – these include lemon top pottles, urine culture preservative tubes, sterile no additive tubes (avoid plastic red top tubes as they introduce crystalline artefacts). Mottle top tubes contain a urine preservative and are an excellent choice for urinalysis only.

Collection protocol:

- 5-10 mL is ideal volume
- Prior to fluid administration, if possible
- Cystocentesis is ideal, particularly for culture
- Mid-stream free catch is acceptable for most analyses
- First-morning urine is ideal to assess concentrating ability

Special handling/shipping requirements: Ideally submitted with an ice pack

GENERAL BACKGROUND INFORMATION

Analyses should ideally, be carried out on fresh urine (<1 hour old), which often not possible when submitting to a laboratory. Urine pH may change, crystals may form or disintegrate, bacteria may grow or die, and cells and casts may disintegrate with time and shipment at ambient temperature. To minimise sample degradation, store the sample in the fridge then send with an ice pack. First-morning urine is recommended to assess concentrating ability and for tests like urine cortisol: urine creatinine ratio. First-morning urine is expected to have maximal concentration, and maximal accumulation of cells, casts, bacteria, or other analytes of interest. This urine may be more acidic (which prevents dissolution of proteinaceous structures), and concentrated urine is less likely to lyse cells (USG < 1.008 may result in cell lysis).

Substaging of renal disease is ideally performed on at least 3 urine samples collected over a period of at least 2 weeks.

COLLECTION

Urine can be collected by a variety of methods including cystocentesis, catheterisation, manual expression, voided, or from the floor, table or litter tray when necessary. State the method of collection on the history form, to aid interpretation.

Cystocentesis

This is the collection method of choice, as it is the most sterile and therefore suitable for culture. It is generally considered to be safe, however there are some risks. The most common is microscopic haematuria, which can be hard to differentiate from pathological haemorrhage. Generally, with iatrogenic haemorrhage, there is a 1+ blood on the dipstick, urine is usually not discoloured, nor is there an increase in protein concentration. Other complications include rupture of an overly distended bladder, bladder laceration, inadvertent aspiration of gut contents and peritonitis secondary to leakage of septic urine. If urine is not obtained on the first attempt, use a new needle. Ballottement prior to cystocentesis helps to mix bladder contents, and may increase findings in sediments.

REASONS FOR CYSTOCENTESIS

- Urine culture – helps localise infection to bladder +/- kidney versus urogenital tract
- Helps localise hematuria, pyuria, and bacteriuria
- Avoids contamination from the lower urogenital tract and skin
- Avoids iatrogenic urinary tract infection associated with catheterization
- Part of therapeutic management of blocked cats (early stages).

WHEN NOT TO SAMPLE BY CYSTOCENTESIS

- Insufficient volume of urine in the urinary bladder
- Overlying pyoderma, coagulopathy, local neoplasia (risk of seeding)
- Patient resists abdominal palpation and restraint.

EQUIPMENT NEEDED

- 22-25 g needle, 1½" to 2" (depending on patient size)
- 3-12 cc syringe for diagnostic cystocentesis
- Use clean needle for transferring to the sample tube.

Many techniques are used and reputable resources can be found on the internet. Ultrasound guidance is ideal, but not always possible. Dorsal recumbency and aiming for where isopropyl alcohol pools on the abdomen, is another. In cats, lateral or dorsal recumbency is preferred. In dogs, the technique can be done with the animal standing. In general, immobilise bladder against body wall. Insert needle through ventral abdominal wall and into bladder at an oblique angle, aiming to enter bladder lumen a short distance cranial to urethral junction. This location allows the needle to remain in the bladder lumen as it reduces in size, which may not happen if the needle enters close to the bladder apex.

Free catch / voided urine

This is the least invasive method of collection. Ideally, a mid-stream sample should be collected as this is less likely to contain contaminants from the vulva, prepuce or urethra e.g. cells, bacteria, hair and debris.

- Acceptable for urinalysis and sediment exam.
- Suitable for culture if no other method is possible, however state method of collection on submission form.
- Long handled ladles, foil pie plates, large cups can all be used to collect urine.
- Clean and empty litter trays can be used for cats, although Styrofoam packing peanuts are useful if a cat doesn't like using a litter-free litter tray.
- Manual expression of the bladder is advised on patients who are sedated or anaesthetised as awake patients require greater pressure to induce micturition, often high enough to cause reflux of urine into the ureters.

Catheterisation

This method of collection requires greater technical skill, often requiring sedation or anaesthesia. Sterile technique should be followed for the patient's urinary tract health and integrity of bacterial culture

- Blood (1+ blood on dipstick) and increased numbers of squamous epithelial cells may be seen.
- Can track materials into bladder and cause bladder infection.
- Patients that have indwelling catheters are at greater risk of bacterial UTI's and culture is advised following catheter removal.

URINE TESTS

A basic but essential component of routine urinalysis includes an assessment of the physical properties of urine: colour, clarity, and USG. This is followed by a dipstick (chemical) examination (glucose, bilirubin, urobilinogen, ketones, blood, pH, and protein), and finally, a microscopic examination of the urine sediment.

The dipstick pads for leukocytes, USG, and nitrite are not considered accurate in veterinary species and are not reported.

Colour

- Examine for colour through a clear container utilising a good light source and a white background.
- Colourless to straw coloured in cats and dogs is normal.
- Horses and cattle may have darker yellow urine due to dietary pigments, rabbits and guinea pigs may have darker yellow to reddish brown.
- Horse urine may turn red or brown with storage or exposure to snow. It is thought to be from breakdown products of catecholamines and is not associated with a pathological process.
- Red is caused by erythrocytes, haemoglobin and myoglobin.
- Orange is caused by bilirubin.
- Yellow-green or yellow-brown is caused by biliverdin and bilirubin.
- Various drugs may cause colour changes (unpredictably).
- Pigmenturia can hinder interpretation of other reactions, particularly pH, protein, and ketones.

DIFFERENTIATING HAEMATURIA FROM HAEMOGLOBINURIA FROM MYOGLOBINURIA

	Haematuria	Haemoglobinuria	Myoglobinuria
PCV	WRI	Decreased	WRI
Plasma/serum colour	Colorless / straw	Pink to red	Colorless / straw
Urine colour (pre-spin)	Pink to red	Pink to red	Dark red / brown
Urine blood (haem)	+	+	+
RBCs in urine sediment	+	-	-
AST and CK	WRI	WRI	Increased

WRI = within reference interval

Clarity

- Described in terms such as clear, hazy, slightly cloudy, cloudy and turbid.
- Freshly voided normal urine is usually clear to very slightly cloudy in cats and dogs.
- Horses, rabbits, guinea pigs, and goats may have mildly turbid urine (mucus +/- calcium carbonate crystals).
- Turbidity is due to suspended particles in the urine such as cells, crystals, bacteria, casts, sperm and lipid droplets. The USG is not affected but reading the line on the handheld refractometer may be more difficult.

Urine specific gravity (USG)

- Urine SG is a measurement of the density of urine compared to water. For routine clinical purposes, it is determined using a refractometer.
- Large amounts of protein and glucose will alter the urine SG and should be taken into consideration when interpreting the urine SG results. Urine SG will increase by between 0.003 and 0.005 for every 10g/L of protein and 10 g/L of glucose present.
- Where possible the USG measured before fluid administration.
- Allow refrigerated urine to warm to room temperature for 20 minutes. Cold urine falsely increases USG.
- USG helps verify that an azotaemia is due to renal failure rather than dehydration. Interpret USG along with:
  - Physical examination estimation of hydration status
  - Serum urea, creatinine, and albumin
  - Amount of urine present in bladder
- Dilute urine (SG < 1.008) may cause osmotic lysis of cells
- There is no “normal” USG. Values that indicate adequately vs inadequately concentrated urine are

reasonable guidelines rather than mathematically exact limits.

- On a randomly drawn sample, “adequate” concentrating ability is considered to be indicated by:
  - Dog ≥1.030
  - Cat ≥ 1.035
  - Horse & cattle ≥ 1.025
  - Rabbits 1.003 – 1.036, average 1.016
  - Guinea pigs with uroliths mean USG was 1.007 – 1.023 in one study.
- Causes for urine that is poorly concentrated include endocrinopathies e.g. Cushing’s and diabetes mellitus, hypercalcaemia, *E.coli* urinary tract infections, pyometra, liver failure, drugs e.g. steroids, diuretics.
- Early renal insufficiency may result the loss of concentrating ability prior to the onset of azotemia. In this instance, checking serum SDMA concentrations may help detect early loss of renal function.
- It should be noted that SDMA concentrations can become elevated prior to the loss of concentrating ability, so careful monitoring of urine SG and renal parameters in these patients is advised.
- Cats may maintain some concentrating ability early in renal failure i.e. may be azotemic but not yet isosthenuric.

CONVERSION OF USG RESULTS FROM A MEDICAL REFRACTOMETER TO FELINE URINE USG VALUES:

Conversion calculation: Feline USG = (0.846 x medical refractometer USG) + 0.154

Medical refractometer results	Feline USG
1.005	1.004
1.010	1.008
1.015	1.013
1.020	1.017
1.025	1.021
1.030	1.025
1.035	1.030
1.040	1.034

A NOTE ON REFRACTOMETERS

- Temperature-compensated veterinary-specific refractometers should be used, refractometers calibrated for human urine (“medical refractometers”) give erroneous results for cats, guinea pigs, and rabbits.
- See conversion chart above for converting feline USG if a medical refractometer is used.
- Quality control – distilled water provides an inexpensive zero calibrator; mid and high level calibrators of 5% sodium chloride (1.022 +/- 0.001) and 9% sucrose (1.034 +/- 0.001) can be used respectively.
- Temperature compensated refractometers may never need adjustment, but should be assessed periodically.

Urine Dipstick Results

- Dipsticks consist of chemically impregnated test pads attached to a plastic strip. When the test pad is immersed in urine, a colour producing chemical reaction occurs. Results are generally semi-quantitative.
- Analyse a fresh, well-mixed urine sample, or if refrigerated, allow sample to come to room temperature.
- Submerge test strip briefly into the urine sample (no longer than 1 second) and drain excess urine by blotting the lateral edge of the dipstick against absorbent paper, ensuring urine doesn’t flow from one test pad to another.
- Compare test pad colour reactions at the specified time intervals using the dipstick analysis chart.

- Results from leucocytes, USG and nitrite are not valid in veterinary species.

URINE GLUCOSE

Glucose is a small molecule that passes freely through the glomerulus into the ultrafiltrate, where it is reabsorbed by the proximal renal tubular cells. Glucosuria can be *transient* e.g. stress hyperglycaemia in cats, cattle and camelids and in dogs with acute pancreatitis. It can also be *persistent* e.g. due to diabetes mellitus, occasionally with Cushing's disease (due to endogenous steroids), and acromegaly. Use of certain drugs (e.g. xylazine, glucocorticoids and progesterone) and ethylene glycol toxicity may cause glucosuria. Tubular dysfunction can result in glucosuria without hyperglycaemia e.g. acquired or congenital Fanconi syndrome. Puppies <8 weeks of age may have a mild glucosuria due to tubular immaturity.

Renal threshold of glucose in SI units, with conventional units in parenthesis:

- 10-12 mmol/L Canine (180-220 mg/dL)
- 16 mmol/L Feline (280 mg/dL)
- 8 mmol/L Equine (150 mg/dL)
- 6 mmol/L Bovine (100 mg/dL)

False positive results can occur when there are oxidising agents present. An example would be collection of urine from a table or cage floor where hydrogen peroxide or chloride bleach was present.

False negative results can occur in the presence of ascorbic acid, with marked bilirubinuria and in very concentrated samples or cold samples not brought to room temperature.

Glucose increases the urine SG by 0.004 for each 55 mmol/L or 2.5 g/dL

3+ Glucose (>0.06 mmol/L or >1 g/dL) adds 0.004 – 0.005 to USG

4+ Glucose (>0.11 mmol/L or >2 g/dL) adds 0.008 – 0.010 to USG

URINE BILIRUBIN

With the exception of the dog, which has a low renal threshold, bilirubin is not expected in the urine of domestic mammals. Because of the low urine threshold, dogs can have a trace to 1+ reaction, especially in well concentrated samples. Male dogs also have the ability to conjugate bilirubin in their renal tubules, which can lead to a positive result. The cat renal threshold is at least 9 times higher than in dogs, and thus any bilirubin is significant in this species.

Detection of bilirubin in urine is indicative of cholestatic hepatobiliary disease, functional cholestasis (due to extrahepatic sepsis) or haemolysis (free haemoglobin is conjugated to bilirubin in the renal tubular cells). In dogs, due to the low renal threshold, bilirubinuria can precede the onset of hyperbilirubinaemia.

Occasionally, bilirubin crystals will be present in the urine sediment but the dipstick pad is negative for bilirubin. The cause of this is unknown, but the presence of crystals is likely to indicate bilirubinuria.

False positive reactions can occur in deeply pigmented urine, with the presence of metabolites of the NSAID drug etodolac and with indican, an intestinal bacterial metabolite.

False negative results may occur with sample aging, exposure to UV light, nitrites, ascorbic acid.

UROBILINOGEN

Not routinely used in veterinary species due to unreliable results but a positive result indicates an unobstructed biliary system and that urine is fresh.

URINE KETONES

Ketones are intermediate products of fat metabolism and form secondary to excess lipid mobilisation. Their presence indicates a state of negative energy balance. The ketone bodies, acetoacetate and acetone, are detected by the dipstick ketone pad, whereas beta-hydroxyacetate (BOHB) is not. The colour change on the pad is

subtle, leading to false positive trace or small reactions, especially in well concentrated urine or urine containing blood or haemoglobin.

Some specific examples of ketonuria include:

- Diabetic ketoacidosis in cats and dogs.
- Bovine ketosis and pregnancy toxaemia in ewes and camelids. BOHB is predominant "ketone" formed in these species, dipstick does not detect BOHB.
- Starvation or malnutrition, especially in immature animals, and with low carbohydrate diets.

URINE BLOOD

A positive dipstick reaction for blood can result from haematuria, haemoglobinuria or myoglobinuria and the presence of any of these substances in urine is abnormal.

- Haematuria can be macroscopic or microscopic and is due to the presence of intact RBC. A minimum of 5-20/uL is needed to produce a positive reaction.
- Haematuria can result from haemorrhage anywhere along the urinary tract. Some causes include infection, inflammation, trauma, rodenticide toxicity, uroliths, neoplasia and idiopathic renal haematuria. False positive results could potentially occur with contamination from the genital tract e.g. a free catch sample from a bitch in heat.
- Cystocentesis and catheterisation can induce microscopic haematuria and a trace to 1+ blood reaction on dipstick.
- If reaction is caused by haematuria, the urine sample will go from pink to yellow and a button of RBCs will form in the bottom of the tube after centrifugation of the urine sample.
- A positive blood reaction but a lack of intact RBCs in the sediment can occur with haemoglobinuria, myoglobinuria, very small numbers of RBCs, or lysis of red blood cells (common with dilute urine).
- Haemoglobinuria is caused by intravascular haemolysis and myoglobinuria by severe muscle injury due to rhabdomyolysis.
- False positive reactions can occur with bleach (home urine containers should be clean but not "sterilised" by using bleach for this reason).

URINE PH

- Many renal and extra-renal factors affect urine pH. Carnivores usually have acidic urine, whereas herbivores usually have alkaline urine, unless on a milk diet.
- Knowledge of the urine pH is important when interpreting urine sediment as alkaline urine is more likely to result in disintegration of erythrocytes, leucocytes and casts. Alkaline urine can also cause a falsely elevated pH reading on the dipstick pad.
- A false decrease in the pH pad reading can occur if urine leaks across from the protein pad.
- Normal urine pH:
  - Dog and cat: 6.5 – 7.5
  - Equine and bovine: 7.5 – 8.5

Some factors that influence urine pH include:

- Diet - elevated pH in dogs and cats after eating, the postprandial alkaline tide, is due to increased secretion of HCl into the stomach. Dogs that have a large proportion of their diet as vegetables, will have a high urine pH.
- Abnormal acid/base balance or tubular dysfunction.
- Age of specimen – loss of CO_2 to the air occurs, raising pH.
- Presence of bacteria – urease-positive bacteria such as Streptococcus, *Ureaplasma* or *Proteus* spp. convert urea to ammonia, which will increase the pH. A persistently alkaline urine should raise suspicions for a UTI. Infection with these bacteria can lead to concurrent urolith formation as crystals precipitate out more readily in alkaline urine.
- Acidic urine in cows raises concern for displaced abomasum or upper GI foreign body.

URINE PROTEIN

- Proteinuria may be:
  - Pre-renal – also called overload proteinuria and occurs when the amount of filtered protein is in excess of the ability of the renal tubules absorptive capacity. Examples include colostral proteinuria in neonates <40 hours old; excess free light chains associated with plasma cell malignancies; haemoglobinuria and myoglobinuria.
  - Renal **–** renal proteinuria is defined as persistently elevated UPCR >0.5, where pre- and post-renal proteinuria have been ruled out. It may be of glomerular, tubular or interstitial origin.
    - Glomerular proteinuria can be functional e.g. due to stress, fever, excitement and congestive heart failure OR pathological due to amyloidosis and glomerulonephritis. The proteinuria is generally moderate to marked and can result in hypoalbuminaemia and other complications if loss is prolonged or severe.
    - Tubular proteinuria can either be due to reduced tubular function resulting in decreased absorption or increased excretion of proteins by damaged tubules. There are many causes including renal ischaemia due to hypoxia or hypotension, toxic insults, infectious diseases.
    - Interstitial proteinuria less common and due to inflammation or haemorrhage within the kidney.
  - Post-renal – lower urinary or genital tract inflammation or haemorrhage. Note that microscopic haematuria associated with cystocentesis does not usually result in haematuria.
- The protein pad on the dipstick is more sensitive to albumin than globulins and is insensitive to Bence-Jones proteins.
- Interpret results in light of the urine specific gravity and pH.
- Normal urine contains little to no detectable protein so proteinuria in the absence of inflammatory sediment or blood, i.e. a quiet sediment, is evidence of renal protein loss. Trace to 1+ results can occur in well concentrated samples of >1.030, however in dilute samples would be abnormal, as would a 2+ or more in a well concentrated sample.
- Albumin in urine increases USG by 0.003 for each 10 g/L.
- Confirm dipstick results with a urine protein:creatinine ratio as the dipstick result is only subjective. (UPCR; see Quantitative Urinalysis section below).

False positives – highly alkaline urine, highly pigmented samples, prolonged immersion of urine sample, run over between pH and protein test pad, and presence of chlorhexidine skin cleanser.

False negatives – Bence-Jones proteins are not detected due to insensitivity of the protein dipstick pad; microalbuminuria where protein concentrations are very low; highly acidic urine.

Sediment Examination

This is a microscopic examination of the post-centrifugation urine sediment. Casts are enumerated at 10x (LPF). WBC, RBC, epithelial cells, crystals, and bacteria are enumerated at 40x (HPF). It can be very useful to make an air-dried (using a fan) urine sediment preparation and stain it with Diff-Quik to help identify cell types and bacteria. Wet-urine stains (e.g., Sedi-Stain™) are prone to forming precipitates that look exactly like cocci.

RED CELLS

- Increased numbers of red blood cells can be due to haemorrhage, inflammation, necrosis, trauma or neoplasia anywhere along the urinary tract or urogenital tract in voided specimens.
- Method of collection is important to know as catheterisation and cystocentesis can cause iatrogenic haemorrhage.
- Less than 5 RBC/hpf is considered acceptable for normal urine.
- Can lyse in dilute <1.008 or alkaline urine.

WHITE CELLS

- Increased numbers of leucocytes is called pyuria and indicates an inflammatory process along the urinary tract or urogenital tract in voided samples. Causes include infection, uroliths or tumours.
- Less than 5 WBC/hpf is considered acceptable.

- Pyuria in the absence of bacteria may still be due to a UTI so culture may be indicated.
- Can lyse in dilute of <1.008 or alkaline urine.

CASTS

- <2 hyaline or fine granular casts per 10x field is considered “normal”; 3 or more is considered abnormal.
- All other kinds of casts are considered abnormal at any number.
- Absence of casts does not rule out renal disease.
- Casts degenerate with time and especially in alkaline urine.

SQUAMOUS EPITHELIAL CELLS

- Generally represent contamination from genital tract or skin.
- Frequently seen as contaminants in voided urine samples and in samples collected by catheterisation.
- If noted in high numbers in an intact male dog, causes concern for squamous metaplasia of the prostate. This is generally due to increased quantities of oestrogen which can be secreted by testicular tumours (particularly Sertoli cell tumours, occasionally interstitial tumours).

TRANSITIONAL EPITHELIAL CELLS

- Originate from renal pelvis, ureters, urinary bladder, and urethra and naturally slough into the urine in low numbers so none to a few can be seen in the urine from healthy animals.
- Traumatic catheterisation of the bladder may result in increased numbers.
- In large numbers, especially in clusters, can be indicative of a transitional cell tumour.
- Examination of a stained, air dried sediment smear is indicated if atypical cells are seen and neoplasia is suspected.

BACTERIA

- Bacteria can be insignificant contaminants or important pathogens.
- Differentiation between these two scenarios depends on clinical signs, method of collection, results of sediment examination etc.
- Bacteriuria in the absence of pyuria, can occur in animals that are immune-suppressed (Cushing’s, diabetes mellitus, FeLV, FIV etc.) or in patients with pyelonephritis.
- It can take 10,000 rods or 100,000 cocci/mL urine before they will reliably spin down into the sediment, so if none are observed it does not mean they are not presence, rather they are below the detectable limit.
- An air-dried and stained (Diff-Quik) preparation is recommended in cases where a UTI is suspected but bacteria are not apparent.

CRYSTALS

- Crystals can be seen in the urine of healthy animals so the clinical significance of crystalluria should always be interpreted with clinical signs and other urinalysis data. Detection of crystals does not predict the presence of uroliths.
- Crystals can dissolve or form in vitro, particularly with time and temperature alterations.
- In patients with confirmed urolithiasis, the microscopic evaluation of the crystal composition should not be used as the sole criterion of the mineral composition of bladder stones or urethral plugs.

Crystals found more commonly in acidic urine (but not always):

- Bilirubin: bilirubinuria, cholestasis; in dogs is often of no clinical significance
- Calcium oxalate dihydrate: low numbers in health; suggests hypercalciuria +/- hyperoxaluria; if animal in acute renal failure, suggest ethylene glycol toxicity (antifreeze)
- Calcium oxalate monohydrate: rare in healthy animals; high numbers are associated with ethylene glycol toxicity
- Cysteine: rare; suggests liver dysfunction in breeds other than: Newfoundland, English Bulldog, Dachshund, Chihuahua, Mastiff, Australian Cattle Dog, Bullmastiff, American Staffordshire Terrier
- Drug crystals: Sulpha-containing drugs, contrast media, primidone
- Tyrosine: very rare; suggests liver disease

- Uric acid: seen in Dalmatians, English bull dogs; may suggest liver dysfunction and/or portosystemic shunt in other breeds of dogs and in cats
- Xanthine: rare; may reflect treatment with allopurinol

Crystals more commonly found in alkaline urine (but not always):

- Ammonium biurate: more common in Dalmatians and English Bulldogs; suggest liver dysfunction and portosystemic shunt in other breeds and in cats
- Calcium carbonate: normal in horses, rabbits, guinea pigs, and goats
- Calcium phosphate / amorphous phosphate: seen in healthy mammals; may be seen with calcium-phosphate uroliths
- Struvite (magnesium ammonium phosphate): often seen in the urine of clinically normal dogs, cats, and guinea pigs; cats with feline idiopathic cystitis; UTI with urease-positive bacteria promotes struvite crystalluria; uroliths of any composition

Quantitative Aspects of Urinalysis

URINE PROTEIN:CREATININE RATIO (UPCR)

- Used to confirm dipstick proteinuria
- On random mid-day urine samples, it correlates with the "gold standard" 24-hour urine collection, for quantifying urinary protein loss.
- It is unaffected by urine volume or concentration
- A full urinalysis is ideally done on the same sample to rule out haematuria, inflammation, or a UTI as these can result in proteinuria and make the result invalid
- Dogs on immunosuppressive doses of corticosteroids will have a mildly (up to 1.3) increase in ratio due to mesangial cell proliferation

Interpretation of the UPCR

Renal proteinuria is defined as persistently elevated UP/Cs greater than 0.5 in dogs, & > 0.4 in cats in which pre- and postrenal proteinuria has been ruled out. They may be of glomerular or tubulointerstitial origin. Proteinuria between 0.2 – 2.0 may be tubular or glomerular; proteinuria >2.0 is considered glomerular; the higher the ratio the more likely there is to be primary glomerular disease present.

IRIS (International Renal Interest Society www.iris-kidney.com) recommends that at least 3 urine samples are collected over a period of at least 2 weeks for sub-staging renal disease.

UP/C value		Substage
Dogs	Cats	
<0.2	<0.2	Non-proteinuric
0.2 – 0.5	0.2 – 0.4	Borderline proteinuric
>0.5	>0.4	Proteinuric

URINE CORTISOL:CREATININE RATIO (UCCR)

- See Endocrinology chapter – diagnosis of hyperadrenocorticism
- Screening test for canine hyperadrenocorticism as a low (normal) result makes the disease unlikely
- Useful in cases where hyperadrenocorticism is unlikely but needs to be definitely excluded
- Low specificity (many false positives) so further tests are required to confirm that a high result is due to hyperadrenocorticism (i.e., low dose dexamethasone suppression testing +/- ultrasonographic adrenal imaging)
- It is thought that the test has similar sensitivity and specificity in cats but there are few published reports

Interpretation of UCCR in Dogs

Normal Value $<10 \times 10^{-6}$

Equivocal $10 – 15 \times 10^{-6}$

Increased $>15 \times 10^{-6}$

URINE FRACTIONAL EXCRETION

- Fractional excretion (FE) of an analyte (FEx), frequently an electrolyte but sometimes a mineral, is determined by both glomerular filtration and tubular reabsorption. It provides an estimate, expressed as a percentage, of the amount of analyte excreted in the urine so indirectly assesses the ability of the renal tubules to reabsorb an analyte.
- Most commonly used to determine if a decrease in Na, Cl, Ca, or PO4 noted on the biochemical profile, is due to excessive renal loss of that substance. FE results should always be interpreted in relation to serum concentration of the analyte
- As these electrolytes and minerals are reabsorbed by tubules, FEx is an indicator of tubular function e.g., K-losing nephropathy in cats. If FEx is normal, then loss is occurring elsewhere
- Calculation is similar to that for UPCR (i.e., a percentage of urinary creatinine excretion). Requires simultaneously collected urine sample and serum sample.
- The formula for FE electrolyte is FE = (urine electrolyte/serum electrolyte) ÷ (urine creatinine/serum creatinine) x 100
- Results are influenced not only by renal tubular function, but by age, breed, gender, diet, biological rhythms and exercise and these should always be taken into account when interpreting results

Normal FE of some analytes in dogs and cats

Analyte	Dog	Cat
Sodium	<1%	<1%
Chloride	<1%	1.3%
Potassium	<20%	<24%
Phosphorus	<39%	73%