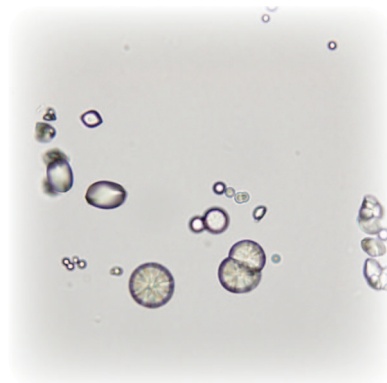
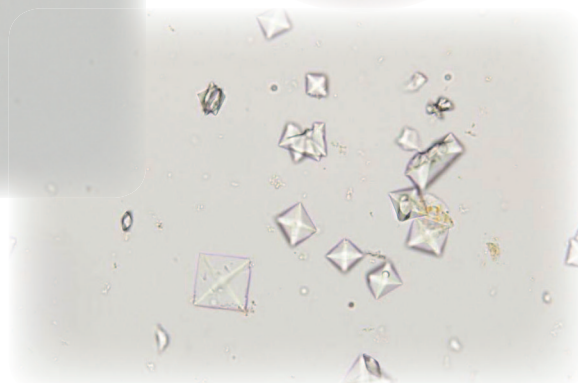
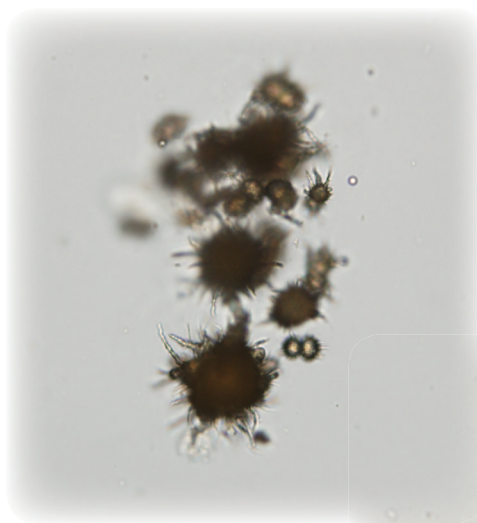




# URINALYSIS IN COMPANION ANIMALS

## Part 1: Collection, Sample Handling, & Initial Evaluation

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Urinalysis (UA) provides information about the urinary system as well as other body systems. It is usually performed in-clinic rather than being sent to an outside laboratory, which is why it is important for the veterinary team to be able to effectively evaluate a complete UA.

The UA is designed to provide information needed to pursue a particular clinical problem or as part of a health screen. Therefore, it is usually included as part of the minimum database of diagnostic tests, along with a complete blood count (CBC) and clinical biochemistry profile.

The UA should be performed to (Table 1):

- Evaluate any animal with clinical signs related to the urinary tract
- Assess an animal with systemic illness
- Monitor response to treatment.

### COLLECTION OF URINE

Method of collection is important to know because it can influence the interpretation of results. The 3 ways to collect urine for analysis are (Table 2):

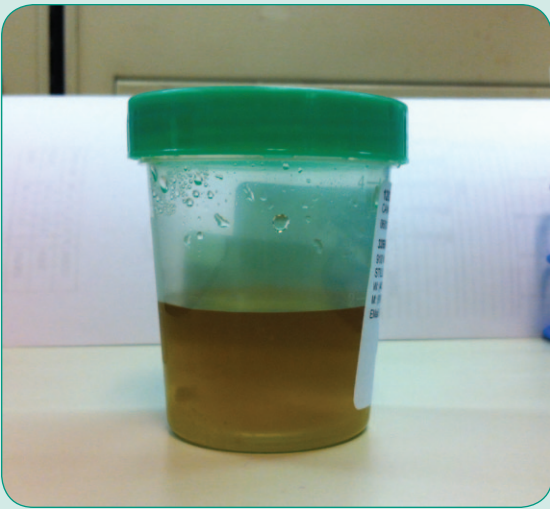
1. Free catch
2. Catheterization
3. Cystocentesis.

### Free-Catch Collection

Free-catch samples are easy to obtain. Urine should be collected in a clean container with a tight fitting lid that is available from medical supply companies (Figure 1). Discourage owners from using containers from home, which may contain contaminants, such as detergent, food, and medications, that may alter chemistry results.

TABLE 1. Indications for Performing a Urinalysis

- As part of diagnostic minimum database
- Azotemia
- Dysuria/stranguria
- Hematuria
- Pigmenturia
- Pollakiuria
- Polyuria/polydipsia
- Monitor response to urinary tract disease treatment
- Urinary incontinence



**Figure 1.** Secure clean container with lid for routine urinalysis.

Samples can be obtained via normal voiding or by manual compression of the urinary bladder. A mid-stream sample is preferred. The disadvantage of a voided free-catch sample is potential contamination with cells, bacteria, and debris from the distal urethra, genital tract, and external skin.

Free-catch samples that are positive for white cells, bacteria, and protein will necessitate sampling via cystocentesis (or catheter) in small animal patients.

### Catheterization

Catheterization of the urinary bladder is performed using a sterile urinary catheter; the external genital area and distal urethral opening are aseptically prepared; however, contamination of the sample may still occur. In addition, catheterization may cause iatrogenic urinary tract infections by introducing bacteria into the urinary bladder, and is more likely to add red cells and transitional cells to the sample due to mild trauma that results as the catheter passes through the urethra.

**TABLE 2. Advantages & Disadvantages of Sampling Methods**

#### FREE CATCH

<b>Advantages</b>	<ul style="list-style-type: none"> <li>• <b>Normal voiding:</b> No risk and pet owners can obtain samples</li> <li>• <b>Manual compression:</b> Distended urinary bladder compressed at convenience of collector</li> </ul>
<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• <b>Both methods:</b> Samples are often contaminated</li> <li>• <b>Manual compression:</b> (1) Urinary bladder may be traumatized, (2) infected urine may be forced into ureters, kidneys, and prostate, (3) technique cannot be used immediately post cystotomy, and may be uncomfortable in other postoperative laparotomy patients</li> </ul>

#### CATHETERIZATION

<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Bladder does not have to be distended</li> </ul>
<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• Can only be performed by trained personnel</li> <li>• Risk for iatrogenic infection, blood and cellular contaminants</li> <li>• Risk for trauma or perforation of the urethra or urinary bladder</li> <li>• Not possible if there is urethral obstruction</li> </ul>

#### CYSTOCENTESIS

<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Less risk for iatrogenic infection and contaminants</li> <li>• Localizes source of cells and/or bacteria</li> </ul>
<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• Can only be performed by trained personnel</li> <li>• Must have sufficient amount of urine in bladder to perform</li> <li>• Risk for microscopic hematuria</li> <li>• Inadvertent intestinal sampling</li> <li>• Urinary bladder tear (very rare), leakage of urine into abdomen (usually only a very small amount that is not clinically important, but risk is greatest in animals with severe bladder distension due to urethral obstruction, or those with severe disease of the bladder wall)</li> <li>• Contraindicated in the presence of a coagulopathy or anti-coagulant therapy</li> </ul>

## STEP-BY-STEP: CYSTOCENTESIS

### Bladder Isolation Technique

#### Equipment Needed

- 6- to 12-mL syringe
- 22-gauge needle, 1 to 1.5 inches (dependent on animal size)
- Ethanol

1. Assemble equipment and attach needle to syringe.
2. Restrain the animal in lateral recumbency. In some dogs, the bladder may be easily palpated while standing.
3. Palpate the urinary bladder, located in the caudal abdomen, to determine if bladder contains enough urine.
4. Clean the caudal abdomen skin with ethanol.
5. Gently isolate the bladder between the fingers of one hand.
6. Once the bladder is isolated, insert the needle without applying negative pressure, at an approximate 45-degree angle.
7. At the appropriate depth, slowly draw back the syringe plunger to aspirate the desired volume of urine.
8. When the desired volume of urine is obtained, release the syringe plunger and withdraw the needle.

### Ultrasound-Guided Technique

#### Equipment Needed

- As listed above
- Ultrasound unit

1. Assemble equipment and attach needle to syringe.
2. Restrain the animal in dorsal or lateral recumbency and spray the caudal abdomen skin with ethanol.
3. Apply the ultrasound transducer to the surface of the abdomen and visualize the urinary bladder.
4. While visualizing the urinary bladder, insert the needle as previously described to aspirate the desired volume of urine.
5. When the desired volume of urine is obtained, release the syringe plunger and withdraw the needle.

### Cystocentesis

Cystocentesis of the urinary bladder is generally easy to perform in small animals. It is the preferred method of urine collection when evaluating the significance of cells or bacteria in the urine or obtaining urine for culture. Mild blood contamination may be seen in cystocentesis-obtained urine samples.

Although urine leak or hemorrhage is possible following cystocentesis, the incidence of these complications is exceedingly rare and should not deter the practitioner from performing cystocentesis in the vast majority of patients. See **Step-by-Step: Cystocentesis—Bladder Isolation Technique**.

### SAMPLE HANDLING

Once a sample is collected, UA should be performed within the hour to avoid artifactual changes that occur as cells and casts deteriorate. If the urine cannot be examined within that time, or will be shipped to a laboratory, the lid should be tightly secured and the sample refrigerated to slow the rate of artifactual changes. Refrigerated and sealed samples are valid up to approximately 6 hours. Most laboratories suggest shipping the sample with a cold pack to delay onset of artifactual changes (**Table 3**).

Samples that will be:

- **Tested in-house** are typically collected in a clean container, free of disinfectants that can alter the results of chemistry tests
- **Shipped to an outside laboratory for biochemical analysis or cytologic examination** should contain several mLs of urine sent in a clean, secured collection container for routine biochemical analysis and sediment evaluation, or in an EDTA tube for cytologic evaluation of the the sediment. Alternately, an air-dried slide of sediment can be sent for staining and evaluation by a veterinary clinical pathologist if suspected cellular atypia is present.

**TABLE 3. Artifactual Changes of Delayed Examination<sup>1</sup>**

- Bacterial (real or contaminant) overgrowth
- Color changes
- Decreased bilirubin
- Decreased glucose
- Decreased ketones
- Deterioration of casts
- Deterioration of cells
- Dissolution of crystals (dependent on type and urine pH)
- Formation of crystals (dependent on type, storage temperature, and urine pH)
- Increased odor
- Increased turbidity
- Increased urine pH

- **Shipped for culture** should be obtained by cystocentesis, which is the preferred method. Samples obtained via mid-stream free catch or aseptic catheterization are acceptable if a quantitative culture is performed so that contamination can be ruled out. When urine is obtained by cystocentesis, the needle should be changed before placing the urine in a vacuum tube. Most laboratories prefer at least 1 mL of urine sent in a sterile red top tube with an accompanying cold pack to keep the sample cool. Bacterial proliferation occurs in urine stored at room temperature, thus urine should be refrigerated until shipped.

**EDTA** preserves cell morphology, which is particularly important since cells deteriorate rapidly in urine, and will prevent clotting in samples containing blood. It also has bacteriostatic properties that inhibit bacterial overgrowth in samples containing bacteria.

## EXAMINATION OF URINE

The components of a complete UA are:

1. Evaluation of the urine sample's physical appearance
2. Specific gravity (USG)
3. Urine chemical properties
4. Microscopic examination of urine sediment.

Part 1 of this article will discuss evaluation of the sample's physical appearance and USG, while Part 2, which will be published in the next issue of *Today's Veterinary Practice*, will address evaluation of urine chemistry and sediment.

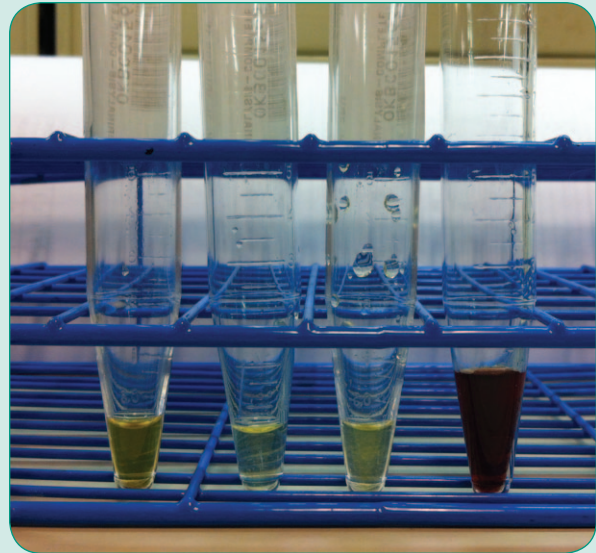
## PHYSICAL APPEARANCE

### Color

The normal color of urine is pale yellow, yellow, or amber (**Figure 2**). Abnormal urine color may be the reason clients seek veterinary attention for their pets (**Table 4**). There are many reasons for abnormal urine color, including issues related to diet, medications, and the pet's environment. It is important to recognize that pigmenturia may interfere with the color change results on the urine chemistry reagent strip test pads.

### Turbidity

Urine is typically clear. Cloudy urine samples may be caused by suspended material, including cells, crystals, bacteria, lipids, and mucus. Causes of turbidity can be further investigated by examining the urine sediment under a microscope, which will be discussed in part 2 of this article.



**Figure 2.** Normal range of urine color (3 samples on left); sample on right is abnormal color.

**TABLE 4.** Causes of Abnormal Urine Color

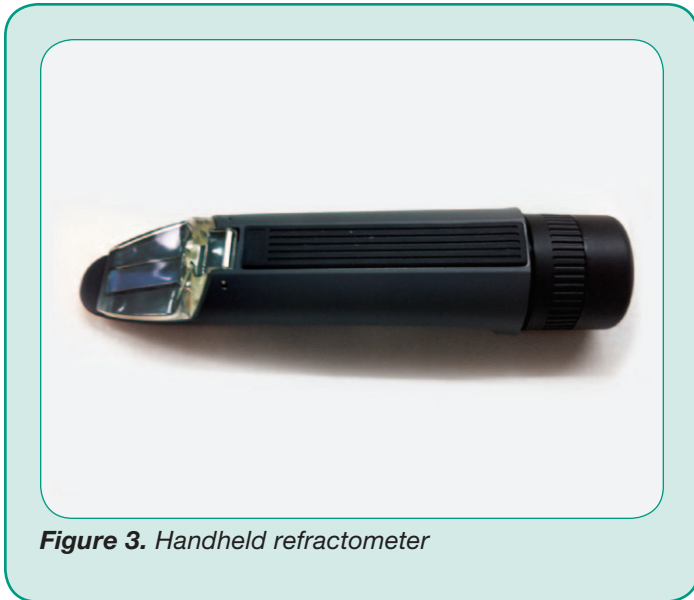
ABNORMAL COLOR	CAUSE
<b>Red</b>	Erythrocytes, hemoglobin, myoglobin
<b>Red-brown</b>	Erythrocytes, hemoglobin, myoglobin, methemoglobin
<b>Brown to black</b>	Methemoglobin from hemoglobin or myoglobin
<b>Yellow-orange</b>	Bilirubin
<b>Yellow-green</b>	Bilirubin or biliverdin
<b>Yellow-brown</b>	Bilirubin or biliverdin

## URINE SPECIFIC GRAVITY

USG indicates the solute concentration of the urine, and is an indicator of the kidneys' ability to concentrate or dilute urine, providing valuable information about one of the kidneys' primary functions.

### Measurement

USG is measured by a refractometer (**Figure 3**). Refractometers are calibrated for the species being tested and many types are available, including digital refractometers. A drop of urine is placed on the glass under the plastic cover; then held up to a light source while the examiner looks through the eyepiece.



**Figure 3.** Handheld refractometer

USG is recorded at the light/dark interface on the scale visualized through the eyepiece. When complete, it is important to wipe the glass without scratching the surface. Scratches on the glass may interfere with USG reading and invalidate results.

**Interpretation**

Interpretation of USG is dependent on several factors:

- Hydration status
- Electrolyte concentrations
- Serum creatinine and urea nitrogen concentrations
- Administration of fluids and/or medications.

Several clinical entities may also alter the kidneys' ability to concentrate urine (**Table 5**).

- **Hyposthenuria** (USG < 1.007) is dilute urine, indicating a specific gravity lower than plasma and glomerular filtrate.
- **Isosthenuria** (USG 1.008–1.012) indicates a specific gravity equal to plasma and glomerular filtrate.

A dehydrated animal with healthy kidney function should excrete a small amount of highly concentrated urine, increasing the USG. If the USG indicates isosthenuria (USG < 1.030 in a dog and < 1.035 in a cat), a detailed history to determine recent medication administration and evaluation of serum creatinine and urea nitrogen concentrations are indicated.

The **maximum urine dilution** in most domestic animals is 1.001, and maximum urine concentrating ability is > 1.080 in cats, > 1.060 in dogs, and > 1.050 in horses and cattle.<sup>1</sup>

**TABLE 5. Select Factors that Decrease Urine Specific Gravity**

<ul style="list-style-type: none"> <li>• Diuretic administration</li> <li>• Glucocorticoid administration (including topical)</li> <li>• Feline hyperthyroidism</li> <li>• Fluid therapy</li> <li>• Hyperadrenocorticism</li> <li>• Hypercalcemia</li> <li>• Hypoadrenocorticism</li> <li>• Hypokalemia</li> <li>• Hyponatremia/hypochloremia</li> <li>• Liver failure</li> <li>• Psychogenic water drinking</li> <li>• Pyometra</li> </ul>
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“Normal” reference intervals for USG may be misleading since there are many variables that contribute to USG. Therefore, the interpretation of USG is always based on the clinical status of the patient and consideration of factors that are known to alter USG. ■

*Read Part 2 of this article—Evaluation of Urine Chemistry & Sediment—in the next issue of Today's Veterinary Practice.*


CBC = complete blood count; UA = urinalysis; USG = urine specific gravity

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**Suggested Reading**

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