ZOETIS DIAGNOSTICS

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AI Urine Sediment

Suggested Reference Intervals

Refer to this resource for a quick overview of 'normal' quantities for urine sediment elements present in a sample.

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Suggested Reference Intervals

The suggested reference intervals outlined in Table 1 refer to the number of urine sediment elements considered "normal" in a urine sample based on collection and handling methods. For accuracy, interpret the results while accounting for patient clinical signs, collection method, urine chemistry analysis, specific gravity, and blood chemistry.

Table 1 *Suggested Reference Intervals of Urine Sediment Elements*

Urine Sediment Element Type	Variations	#Elements/40X(HPF)*
Red Blood Cellls	Voided/Free Catch Collection	0 - 10
	Catheterisation, Non Traumatic	0 - 5
	Catheterisation, Traumatic	> 50
	Cystocentesis, Routine	< 10
	Cystocentesis, Traumatic	> 50
White Blood Cells	Voided/Free Catch Collection	< 10
	Catheterisation	< 7
	Cystocentesis	< 3
Struvite Crystals	Fresh, Warm Urine	0
	Refrigerated/Stored	Few/Moderate
Calcium Oxalate Dihydrate Crystals	Fresh, Warm Urine	0
	Refrigerated/Stored	Few/Moderate
Bacteria	Voided/Catheterised	0 - Few
	Cystocentesis	0
Epithelial Cells	Squamous	0 - Few
	Other	0 - Few†
Casts	Hyaline	0 -2/LPF
	Non-Hyaline	0 - 1/LPF‡

Adapted from Urinalysis in the Dog and Cat (p167) by D. Chew and P.A. Schenck, 2023, Wiley Blackwell.

* All elements recorded per HPF except for casts which are reported per LPF(10X).
† Any renal tubular cell seen is abnormal. Occasional transitional (urothelial) cells with normal morphology may be observed.
‡ Any number of waxy or cellular casts seen is abnormal. A granular cast may be observed in highly concentrated urine.

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Dilution Guide

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Dilution Guide

What is Dilution?

Dilution is the action of making the urine sample more dilute, in order to evaluate a less concentrated urine sediment sample (Figure 1). This process facilitates element identification as it ensures formed elements are adequately spaced with no overlap.

When and Why to Dilute?

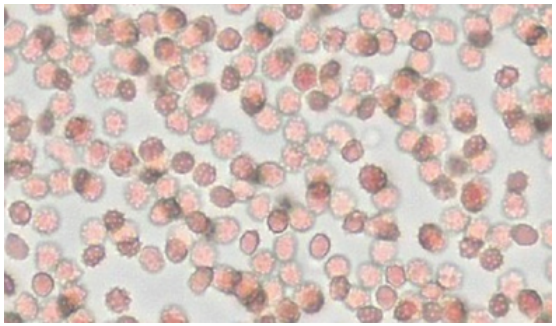
It is important to evaluate the colour and clarity of the urine sample to determine if dilution is necessary (See Table 2).

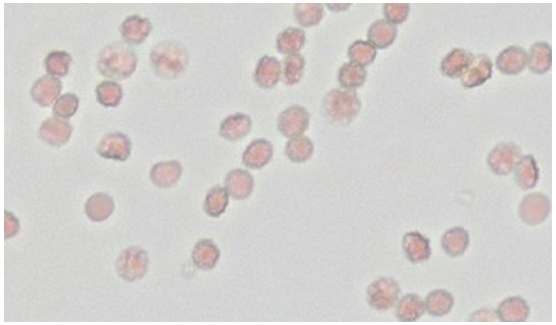
Be sure you're using a clear specimen container to evaluate urine colour and clarity.

Several factors can create abnormal urine colour, such as metabolic or pathological conditions, muscle damage, or drug intake. Turbidity can occur due to crystals, cells, mucous, fat, bacteria, casts, and potentially spermatozoa in the urine.

A urine sediment evaluation is essential to determine which formed elements are contributing to the colour and clarity of the urine sample.

Figure 1 *Pre- and Post-Dilution (1:8) of a Haematuric Sample (40x)*





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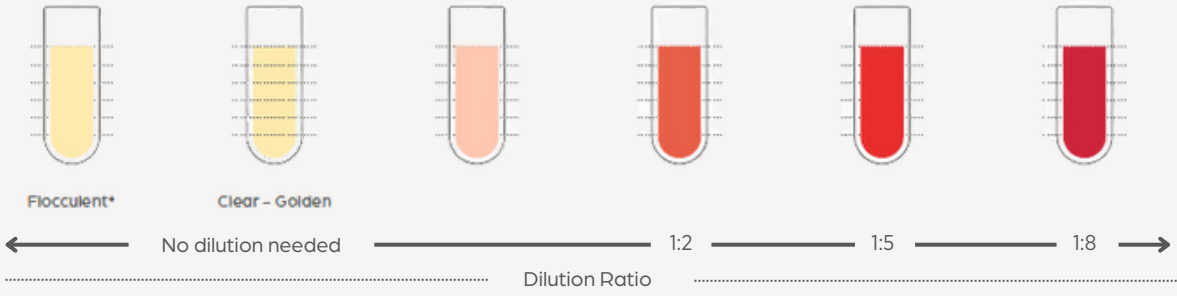
Dilution Guide

Gross haematuria, when blood is visible in urine, is the most common reason to perform a dilution. The pre- and post-centrifugation colour guide provided (Figure 2) can help you determine if a dilution should be performed prior to scanning the urine sediment sample.

The intensity of orange-red colour observed will inform the dilution ratio. While the guide provides suggested dilution ratios, a veterinary professional will need to determine the appropriate dilution for a given sample.

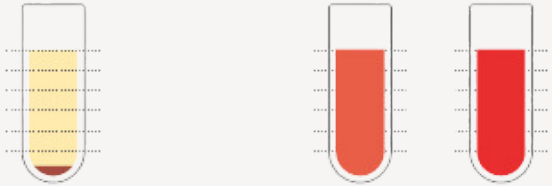
Figure 2 *Suggested Dilution Ratios Based on the Colour of the Urine Sample*

URINE SAMPLE PRE-CENTRIFUGATION



See Table 1 for additional details on recommended dilution ratios

URINE SAMPLE POST-CENTRIFUGATION



Transparent Supernatant with Pellet

Dilution may be required. See above for recommended ratio based on initial colouration

Red

Consider haemoglobinuria or myoglobinuria. Dilution is probably not necessary (See Table 2).

* A flocculent sample may also require dilution but will often need to be scanned first for accurate clinical determination of dilution need

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Dilution Guide

8 Steps to Dilution

Figure 3 *8 Steps to Dilution Using the Vetscan Imagyst*

If dilution of the sample is needed, the following flowchart provides a step-by-step guide to the process.

1. **Collect 1 mL of the urine sample in the centrifugation tube from the sample kit, noting the colour of the original sample.**
2. **Centrifuge the sample.**
3. **Consult Figure 2 and Table 2 to determine if dilution is necessary**
4. **Pour off the supernatant using the provided micropipette tip with a stopper.**
5. **Following the guidance in Table 1, add the recommended amount of 0.9% NaCl to the centrifugation tube.**
6. **Mix the diluted sample well, then immediately place 20µL on the preprinted slide to scan.**
7. **Note your dilution ratio in the Vetscan Imagyst app before scanning.**
8. **Scan the slide immediately.***

* Evaluating the sample immediately after dilution is vital as dilution can alter pH and osmolality, which can change cellular appearance or lead to non-pathologic crystal formation.

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Dilution Guide

As Figure 3 on the previous page outlines, centrifuge the sample and then drain the supernatant. Choose an appropriate dilution ratio based on colour (Figure 2). Then, add the appropriate amount of sterile saline to reach the new desired concentration (Table 1). Finally, gently re-suspend pellet in the supernatant/saline mixture, place 20µL of the well-mixed sample on the slide, and scan immediately (Figure 4).

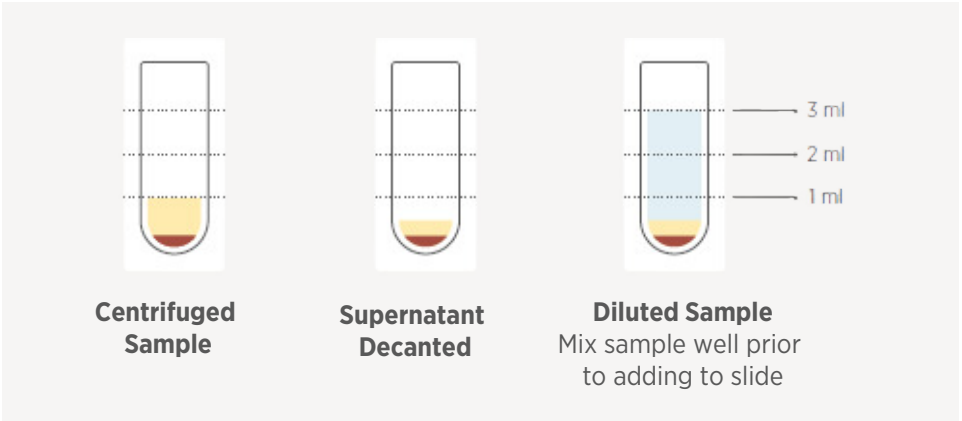
Table 1 *Dilution Preparation*

Add sterile saline (0.9% NaCl) to residual/concentrated urine to reach the desired dilution ratio.

Dilution Ratio (Approximate)	Residual Concentrated Urine Volume*	Sterile Saline Volume (0.9% NaCl)*	Corresponding fill line on sample preparation tube
1:2	0.35 mL	0.65 mL	1 mL
1:5	0.35 mL	1.65 mL	2 mL
1:8	0.35 mL	2.65 mL	3 mL

Figure 4 *Dilution Process*

Centrifuge, decant supernatant, and add the appropriate saline volume. Note that the correct amount of saline will fill the tube to the 1 mL, 2 mL, or 3 mL lines.



* Approximate volume.

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Dilution Guide

The colour of the supernatant after centrifugation is useful to determine the need for dilution. If at **step 3** of Figure 3 the supernatant is pink, red, or brown, the sample may be showing signs of haemoglobinuria or myoglobinuria (Table 2). If this is the case, process the sample without dilution.

Alternatively, if at **step 3** the supernatant clears, the sample is likely red or cloudy due to formed elements like RBCs and/or WBCs. In this instance, dilution is probably necessary.

Table 2 *Interpretation of Pre- and Post-Centrifugation Urine Colour*

	Haematuria	Haemaglobinuria	Myoglobinuria
Colour Pre-centrifugation	Red, Brown, Pink	Red, Brown	Red, Brown
Colour Post-centrifugation	Straw/Yellow	Red, Brown	Red, Brown
RBC present in Urine Sediment?	Many	None to Few	None to Few
Plasma Colour	Normal	Pink	Normal
Other Evidence	Urinary Tract Disease, Traumatic Urine Collection	Anaemia	Muscle Damage

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Interpretation of Bacteria

This overview provides guidelines on how to test for and evaluate the presence of bacteria in a urine sample using the Vetscan Imagyst® AI Urine Sediment Application.

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Interpretation of Bacteria

Bacteria may be present in a urine sample due to a urinary tract infection (UTI) or urine sample contamination. The presence of bacteria (bacteriuria) in a sample does not always mean the patient has a UTI.[1, 2] For this reason, it is imperative to evaluate the sample in the context of the collection method, patient history, other elements present on sediment evaluation (such as white blood cells), and urine culture results.[1]

How to Test for Bacteria

It can be a challenge to differentiate bacteria from amorphous debris and other elements in the urine sediment, even for well-trained veterinary professionals. In one study, it was shown that medical technologists had a misclassification rate of 62% in identifying rods, cocci, or mixed infections when looking at wet, unstained urine sediments that were confirmed positive for bacteria by urine culture.[2]

After reviewing results, it may be necessary to confirm the presence and species of bacteria using an air-dried sediment smear and/or a urine culture and sensitivity test.[1]

Figure 1 *Intracellular Cocci Bacteria*

Cytological evaluation of a dried, stained urine sediment smear reveals intracellular bacteria.

1. Skeldon, N. and Ristić, J. BSAVA Manual of Canine and Feline Clinical Pathology (3rd Edition). Quedgeley, Gloucester: BSAVA, 2016, p184-205.
2. Sink, C.A. and Weinstein, N.M. Practical Veterinary Urinalysis. Wiley-Blackwell, 2016, p134.

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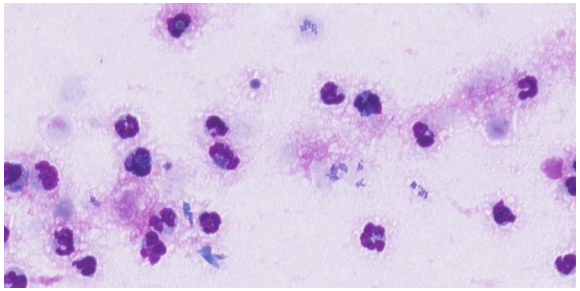
Interpretation of Bacteria

Figure 2 *Cytological Evaluation of a Urine Sediment Smear The presence of neutrophils, extracellular, and intracellular bacteria on cytological evaluation of a dried, stained urine sediment smear indicates an active UTI.*



Air–Dried Urine Sediment Smear Slide Examination

To prepare an air-dried stained sediment smear, add a drop of the remaining well-mixed sediment to the end of a slide. Use another clean slide to spread the liquid across the first slide and then allow the smear to dry. When the slide is dry, stain it like you would any other cytology sample. The smear can be evaluated microscopically for bacteria and other infectious agents, cellular morphology, and other elements.[1]

Sometimes, a stained air-dried sediment smear will show an absence of bacteria, but it doesn't always rule out an active infection. In fact, a minimum of 100,000 cocci/mL and 10,000 rods/mL are necessary to detect bacteria on sediment evaluation.[2] Therefore, a sediment smear can be performed as a quick method to potentially rule in the presence of bacteria while waiting on a C&S. It should not be used to rule out bacteria at the expense of a C&S.

Table 1 *Excerpt from a Zoetis Reference Laboratories Urine Culture & Sensitivity Report*

		Media Plated	Culture plated on 09/12/2023
		Culture Results	Growth Present
Urine C&S (Culture & Sensitivity)		**Organism:**	**Escherichia coli**
Urine Collection Method: Cystocentesis		Quantity	4+ Growth (> 100,000 cfu/ml)

Sensitivty	Escherichia coli	Sensitivty	Escherichia coli
Amikacin	S, <=2	Ciprofloxacin	S, <=0.06
Amoxicillin/Clavulanic Acid	S, <=2	Doxycycline	S, 1
Ampicillin	S, <=2	Enrofloxacin	S, <=0.12
Cefalexin	S, 8	Florfenicol	S
Cefovecin	S, <=0.5	Imipenem	S, <=0.25
Cefpodoxime	S, <=0.25	Marbofloxacin	S, <=0.5
Ceftazidime	S, <=0.12	Nitrofurantoin	S, <=16
Ceftiofur	S, <=1	Trimethoprim-sulfamethoxazole	S, <=20
Chloramphenicol	S, 4	Gentamicin	S, <=1

Urine Culture and Sensitivity (C&S) Test

When a UTI is suspected, collection of urine by cystocentesis followed by complete urinalysis and quantitative aerobic bacterial culture are recommended.[3]

Ideally, urine samples are processed immediately to avoid false increases or decreases in bacterial counts. A urine culture and sensitivity test identifies the bacterial isolate(s) and provides information regarding appropriate selection of antimicrobials.[4]

See Table 2 on the next page for guidance on recommended actions following the visualisation of certain Urine Sediment Elements.

1. Sink, C.A. and Weinstein, N.M. Practical Veterinary Urinalysis. Wiley-Blackwell, 2016, p134.
2. Skeldon, N. and Ristić, J. BSAVA Manual of Canine and Feline Clinical Pathology (3rd Edition). Quedgeley, Gloucester: BSAVA, 2016, p184-205.
3. Wong C., Epstein S.E., and Westropp J.L. Antimicrobial susceptibility patterns in urinary tract infections in dogs (2010-2013). J Vet Intern Med. 2015;29:1045–1052.
4. Willard, M. and Tvedten, H. Small Animal Clinical Diagnosis by Laboratory Methods (5th edition). Elsevier Saunders, 2012, p152.

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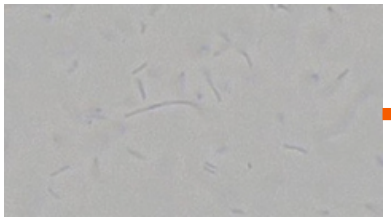
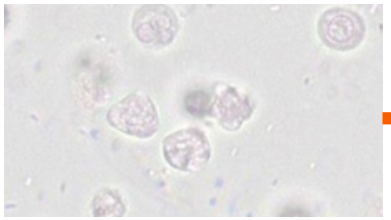
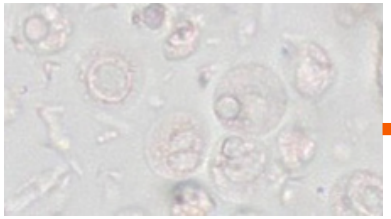
Interpretation of Bacteria

Table 2 *Quick Guide for Interpretation of Possible UTI*

Urine Sediment Elements Visualised		Clinical Signs of UTI Present	Recommended Action
None		No	None
None		Yes	Review WSI. Consider Add-On Expert Review with a stained, air dried smear. Consider C&S.
Bacteria		No	Analyse collection method for sources of contamination. If free-catch, consider cystocentesis and repeating test. If bacteria visualised after cystocentesis, consider C&S, follow ISCAID Guidelines for subclinical bacteriuria[1]
WBC		Yes	Consider sending a C&S. Consider Add-On Expert Review to evaluate WBC morphology.
Bacteria, WBC		Yes	Follow ISCAID Guidelines for further advice on management options.[1] Consider sending urine out for C&S test to identify bacteria and assist in determining appropriate antimicrobial selection.

1. Weese, J.S. et al. International Society for Companion Animal Infectious Diseases (ISCAID) guidelines for the diagnosis and management of bacterial urinary tract infections in dogs and cats. The Veterinary Journal. 247(2019)8–25.

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