Performance of the IDEXX inVue Dx Cellular Analyser for a 6-part white blood cell differential and platelet estimation in cats

Kim Yore, DVM, MS, DACVIM; Corie Drake MS, MBA; and Helen Michael, DVM, PhD, DACVP

Introduction

Blood morphology provides essential insights that cannot always be captured through automated cell counts alone, particularly in cats, whose haematologic parameters present unique diagnostic challenges for automated haematology analysers. Blood morphology complements the complete blood count (CBC) by confirming or updating cell counts from the automated CBC and adding information about the morphology of the cells. Feline platelets have a tendency to clump, requiring a blood morphology evaluation to distinguish between true thrombocytopaenia and pseudothrombocytopaenia caused by the clumping. Furthermore, cats are prone to physiologic leucocytosis, which must be distinguished from an inflammatory leucogram and from circulating neoplastic cells.[1]

The IDEXX inVue Dx™ Cellular Analyser automates blood morphology and overcomes many of the limitations of traditional, in-clinic blood films. The IDEXX inVue Dx analyser uses multiple wavelengths of light and fluorescent stains to visualise cells in a three-dimensional, fluid state within a sample cartridge. The analyser assesses multiple fields of view and uses optical characteristics and positioning of elements within the cartridge to count and identify thousands of cells, including platelets within clumps. As part of its haematology analysis, the IDEXX inVue Dx analyser provides a confirmation or update (when indicated) of white blood cell (WBC) differential cell counts from the CBC on the IDEXX inVue Dx report. Unlike traditional 100-cell differentials, the analyser performs a 6-part differential on 500–2,000 WBCs in the sample, providing more accurate counting of cells. In addition, the IDEXX inVue Dx analyser provides a semiquantitative platelet estimate to provide confidence in platelet numbers even in samples with platelet clumps.

Methods, results and discussion

Precision

Precision (standard deviation [SD]) of the IDEXX inVue Dx analyser was assessed by repeated analysis of feline blood samples 10 times on each of 4 IDEXX inVue Dx analysers. Nine fresh remnant feline blood samples were selected for adequate volume for repeated testing and a range of neutrophil and platelet counts. Based on the data in Table 1, the IDEXX inVue Dx analyser's precision for neutrophils and platelets was considered good for clinical use in cats.

Parameter	Range x 10^9/L	# Samples (9 total)	SD x 10^9/L
Neutrophil			
Neutropaenia	<5	3	0.15
Within reference interval	5–10	3	0.46
Neutrophilia	>10	3	0.18
Platelet			
Marked thrombocytopaenia	<50	2	34.52
Moderate thrombocytopaenia	50–100	3	26.31
Mild thrombocytopaenia	100–150	2	55.49
Adequate	>150	2	26.30

Table 1. Precision for IDEXX inVue Dx mature neutrophil and platelet counts across 9 samples with a range of normal and abnormal neutrophil and platelet counts on the ProCyte Dx Haematology Analyser. For precision testing, each sample was analysed 10 times on each of 4 IDEXX inVue Dx analysers.

Platelet and 6-part WBC differential performance compared to the IDEXX ProCyte Dx Haematology Analyser

Feline EDTA whole blood samples (n = 303) were collected from 16 different sites and analysed within 4 hours of collection on an IDEXX ProCyte Dx™ Haematology Analyser, a CBC analyser validated and shown to have comparable performance to reference laboratory haematology analysers and an IDEXX inVue Dx analyser.[2] Each sample was visually evaluated for clots in the blood collection tube prior to analysis with the ProCyte Dx and IDEXX inVue Dx analysers, and samples with obvious clots in the tube were excluded from analysis. Pearson correlation (*r* values) was used to describe the relationship between the methods when continuous concentrations were produced. Kendall's tau-b, a nonparametric measure of correlation, was used to describe the relationship between semiquantitative categories. For both correlation statistics, a value of 0 indicates no correlation and a value of 1 indicates a perfect positive correlation.

The IDEXX inVue Dx analyser had excellent correlation with the ProCyte Dx analyser for neutrophils, lymphocytes, monocytes and eosinophils, in samples with and without interpretive prompts on the ProCyte Dx CBC results (*r* = 0.80-0.99, Figures 1a–1e). Platelet clumping is common in cats and can result in overestimation of basophils by the ProCyte Dx analyser (Figure 1e).[2] When samples with ProCyte Dx interpretive prompts indicating that platelet clumping may have interfered with the WBC differential were excluded, basophil counts also had excellent correlation (*r* = 0.8)

between the IDEXX inVue Dx and ProCyte Dx analysers. Moderate positive correlation for basophils (r = 0.5) was seen when samples with ProCyte Dx interpretive prompts were included. Samples with these interpretive prompts or with the characteristic dot plot changes on the ProCyte Dx results would benefit from confirmation of basophil counts by IDEXX inVue Dx analysis.

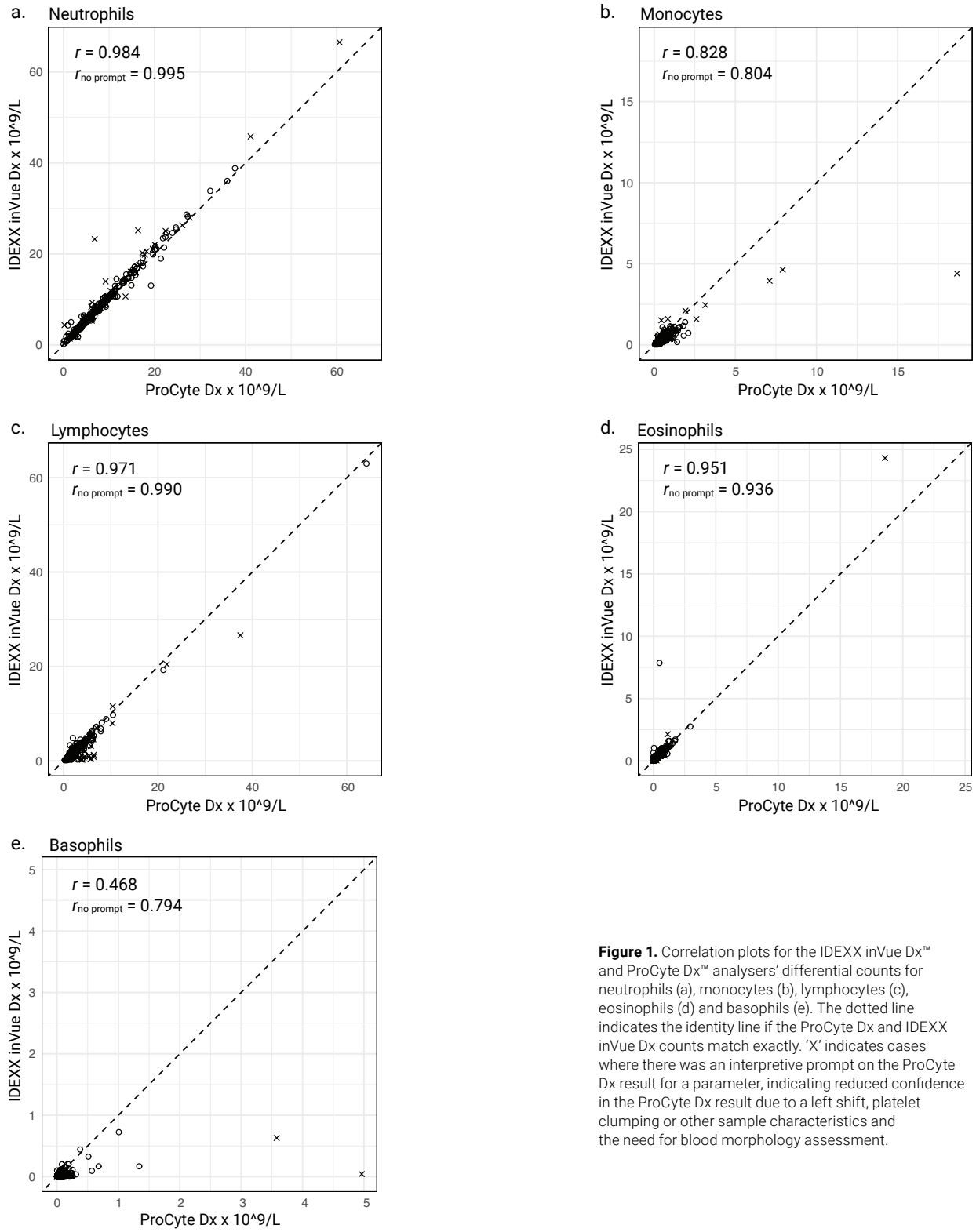
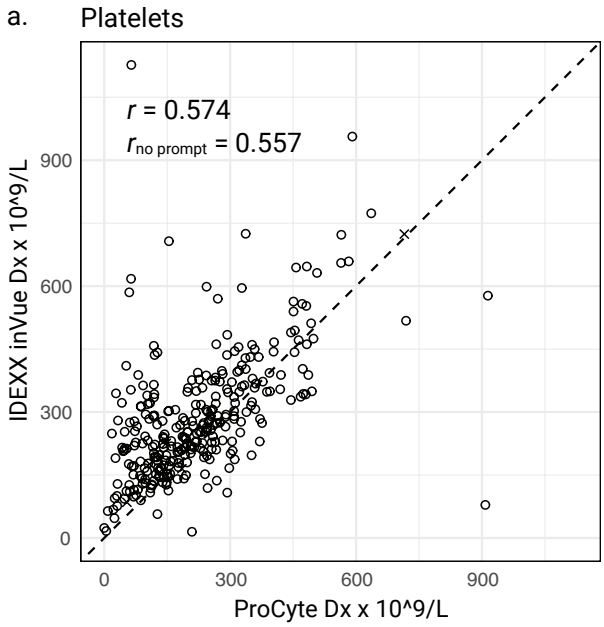
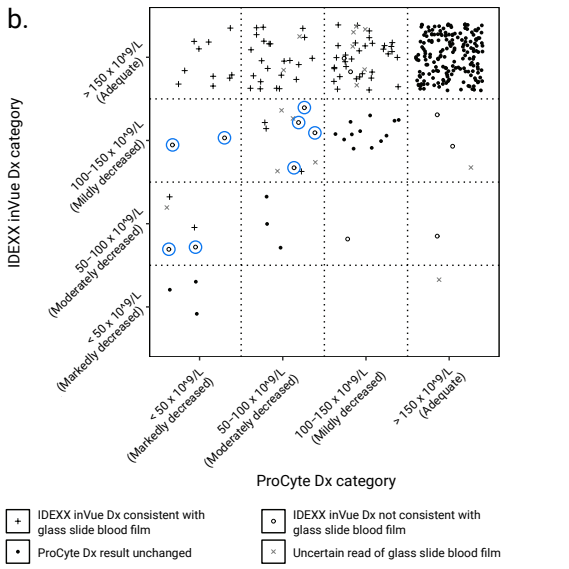


Figure 1. Correlation plots for the IDEXX inVue Dx™ and ProCyte Dx™ analysers' differential counts for neutrophils (a), monocytes (b), lymphocytes (c), eosinophils (d) and basophils (e). The dotted line indicates the identity line if the ProCyte Dx and IDEXX inVue Dx counts match exactly. 'X' indicates cases where there was an interpretive prompt on the ProCyte Dx result for a parameter, indicating reduced confidence in the ProCyte Dx result due to a left shift, platelet clumping or other sample characteristics and the need for blood morphology assessment.

IDEXX inVue Dx analysis provides a semiquantitative platelet estimate, although for the purpose of this study, raw values off the analyser were also assessed against ProCyte Dx platelet counts. There was moderate positive correlation between platelet counts on the two analysers when either including or removing samples with ProCyte Dx 'platelet clumping' interpretive prompts from analysis (Figure 2a). Semiquantitative platelet assessment also showed moderate positive correlation between methods (Kendall's tau-b = 0.43, Figure 2b). Platelet estimates on glass slide blood film reviews were available for 263 samples, shown in Figure 2b. In cases of discordance with the ProCyte Dx CBC count, IDEXX inVue Dx platelet estimates were appropriately updated to a higher semiquantitative bucket based on pathologist glass slide blood film review in all but 6 cases, 2 of which pathologists denoted they were 'entirely unsure' on the platelet estimate. Thus, when ProCyte Dx CBC results revealed low platelet counts, IDEXX inVue Dx analysis appropriately adjusted for platelet clumping and updated the platelet value. A platelet estimate to confirm or update a low platelet count from a CBC haematology analyser is one of the most common reasons for blood film evaluation, now automated by the IDEXX inVue Dx analyser.



ProCyte Dx analyser runs with an interpretive prompt indicating platelet clumps are marked by an 'X'.



In 263 cases where the IDEXX inVue Dx, ProCyte Dx and glass slide blood film analyses were available, IDEXX inVue Dx platelet estimates were appropriately updated to a higher semiquantitative bucket in all but 6 cases, 2 of which had an uncertain platelet estimate on blood film review. In the circled cases, pathologist blood film review revealed 'likely adequate platelets with clumping', creating uncertainty in the exact manual quantification of platelets due to clumping.

Figure 2. Correlation between the IDEXX inVue Dx™ and ProCyte Dx™ analysers for discrete (a) and semiquantitative (b) platelet reporting.

IDEXX inVue Dx analyser performance compared to pathologist manual WBC differentials

6-part WBC differential

The IDEXX inVue Dx analyser provides updated WBC differentials if it detects a clinically significant change in cell counts from the CBC, such as when immature neutrophils and platelet clumping are present. To evaluate the ability of the IDEXX inVue Dx analyser to update differentials, 263 of the 303 samples described above underwent a pathologist blood film review. Samples were stained with modified Wright-Giesma stain (Aerospray™ 7120 Haematology Slide Stainer/Cytocentrifuge, ELITechGroup Inc.) and scanned on a digital slide scanner (MoticEasyScan™ One, software version 1.0.7.50 or 1.0.6.49, Motic Digital Pathology). The IDEXX inVue Dx analyser was compared to traditional blood films by calculating an average of 3 manual 6-part, 200-cell WBC differentials performed by board-certified pathologists.

Correlation between IDEXX inVue Dx results and the average expert manual 200-cell differential is shown in Figures 3a–3d. Correlation of mature neutrophils, lymphocytes and eosinophils remained excellent ($r > 0.9$); monocytes were strong ($r = 0.6$); and basophils were moderate ($r = 0.4$). Manual and IDEXX inVue Dx correlation of immature neutrophils was fair ($r = 0.3$) (Figure 3d). Abnormal cells, like immature neutrophils, have subjective variability in manual counts even with expert observers. Additionally, for cell types present in low numbers, including immature neutrophils and basophils, the higher number of cells evaluated in the IDEXX inVue Dx differential can provide higher confidence in the results. Finally, the IDEXX inVue Dx analyser performed well in identifying other nucleated cells ($r = 0.95$).

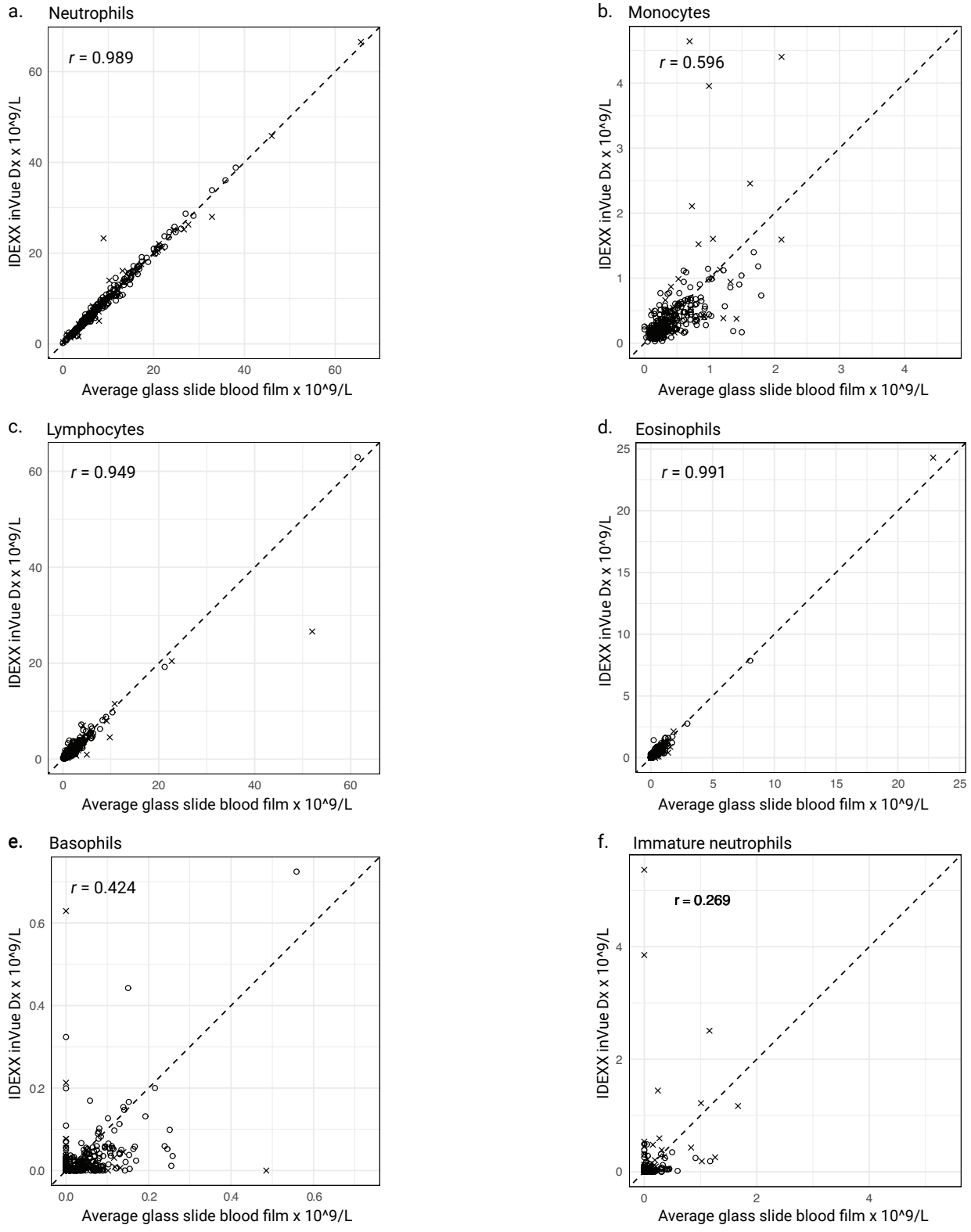


Figure 3. Correlation plots for the IDEXX inVue Dx™ analyser's differential counts to expert manual differentials for neutrophils (a), monocytes (b), lymphocytes (c), eosinophils (d), basophils (e) and immature neutrophils (f). Manual counts were averaged across 3 board-certified pathologists' blood film reviews consisting of 200-cell 6-part differential counts. The dotted line indicates the identity line if the manual and IDEXX inVue Dx differential counts matched exactly. 'X' indicates cases that had an interpretive prompt on ProCyte Dx™ analysis, prompting blood morphology assessment.

Conclusion

The IDEXX inVue Dx™ Cellular Analyser performs blood morphology analysis in cats using its computational power and deep-learning models to produce automated, accurate, algorithm-aided pathology results. The analyser demonstrates excellent correlation to ProCyte Dx automated haematology results and pathologist blood film interpretation when needed to assess morphologic changes within feline blood samples. In clinically unwell patients, and in those whose CBC results from the ProCyte Dx™ or ProCyte One™ haematology analyser suggest the need for morphologic assessment, such as abnormal cell counts, atypical dot plots or analyser messages indicating morphologic changes, the IDEXX inVue Dx Cellular Analyser provides valuable information that complements the CBC and helps guide diagnostic and treatment decisions.

References

1. Schaefer D. Haematologic of cats. In: *Schalm's Veterinary Haematologic.* 7th ed. John Wiley & Sons, 2022;983–992.
2. Goldmann F, Bauer N, Moritz A. Evaluation of the IDEXX ProCyte Dx analyser for dogs and cats compared to the Siemens ADVIA 2120 and manual differential. *Comp Clin Pathol.* 2014;23(2);283–296. doi:10.1007/s00580-012-1608-1