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

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Introduction

Automated haematology analysers have largely replaced the manual counting of blood cells;[1,2] however, microscopic assessment of abnormal white blood cells, clumped platelets and red blood cell morphology is still necessary. Abnormal automated cell counts, abnormal dot plots and interpretive prompts (e.g., an asterisk on the IDEXX ProCyte One* or ProCyte Dx* haematology analyser report) all indicate a need for a blood morphology assessment.[3–6] In a study of more than 400,000 ProCyte One and ProCyte Dx CBCs, two-thirds of CBCs had abnormal cell counts or prompts indicating the need for a blood morphology assessment.[6] Moreover, in another study of cases where blood film review at IDEXX Reference Laboratories followed an in-clinic CBC, three-quarters of those reviews revealed clinically valuable information. Platelet clumping and neutrophil toxic change were the most common findings.[5] Until now, blood morphology has required manual microscopy by trained personnel in-clinic or the sending blood to a laboratory for evaluation. The traditional review of blood morphology on glass slides carries inherent limitations. A high-quality blood film is critical to facilitate a CBC review, interpretation is subjective and the low number of WBCs counted creates inherent error.[1–3,7–10] Clumped platelets can also interfere with platelet estimation on glass slides.[7] Automation, as with the IDEXX inVue Dx* Cellular Analyser, provides an opportunity to minimise operator error, improve efficiency and improve reproducibility of blood morphology assessment. AI-driven tools have been effectively used to generate diagnostic data in human haematology.[8–14]

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 multi-dimensional, fluid state within a sample cartridge. The IDEXX inVue Dx analyser assesses dozens of 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 analyser report. The IDEXX inVue Dx analyser performs a six-part differential on 500–2,000 WBCs in the sample. In addition, a semi-quantitative platelet estimate is reported by the IDEXX inVue Dx analyser, although for the purposes of this study, discrete platelet counts provided in raw data from the analyser were also assessed.

Methods, results and discussion

Precision

The precision (standard deviation, SD) of the IDEXX inVue Dx analyser was assessed by analysing canine blood samples 10 times on each of four IDEXX inVue Dx analysers. Fresh remnant canine blood samples arriving from animal hospitals to the IDEXX Research and Development Laboratory in Westbrook, Maine, were screened for adequate volume and range of cell counts on CBC analysis, resulting in 11 samples for precision testing. The IDEXX inVue Dx analyser had good precision in samples across a range of neutrophil and platelet counts (Table 1).

Parameter	Range (K/µL)	Number of samples	SD (K/µL)
Neutrophil precision			
Neutropenia	< 5	6	0.09
Neutrophils within reference range	5–10	3	0.18
Neutrophilia	> 10	2	0.37
Platelet precision			
Marked thrombocytopenia	< 50	2	8.9
Moderate thrombocytopenia	50–100	3	15.1
Mild thrombocytopenia	100–150	2	15.6
Adequate platelets	> 150	4	19.0

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

Platelet and six-part WBC differential performance compared to the ProCyte Dx analyser

Canine EDTA whole blood samples (n = 348) were collected at a single hospital and analysed within 4 hours of collection for comparison with the ProCyte Dx analyser. Each sample was visually evaluated for clots in the blood collection tube prior to analysis on one of two ProCyte Dx analysers and one of two IDEXX inVue Dx analysers.

All 348 samples were used for WBC differentials evaluation and 322 were used for platelet evaluation due to missing values. Pearson correlation (*r*-values) was used to describe the relationship between the methods when continuous concentrations were obtained. Kendall's tau-b, a non-parametric measure of correlation, was used to describe the relationship between semi-quantitative 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 strong to very strong correlation with the ProCyte Dx* analyser for neutrophils, monocytes and eosinophils in samples with and without interpretive prompts on the ProCyte Dx analyser (Figure 1). In samples without interpretive prompts, lymphocyte counts also had very strong correlation between the IDEXX inVue Dx and ProCyte Dx analysers. When including samples with interpretive prompts indicating a left shift, the IDEXX inVue Dx lymphocyte counts correlated only moderately well due to overestimation of lymphocytes by the ProCyte Dx analyser in cases with immature neutrophils (Figure 1C).[15] In addition to the interpretive prompt, characteristic dot plot changes on the ProCyte Dx analyser on samples with left shifts can be used to identify samples that would benefit from confirmation of the lymphocyte count by IDEXX inVue Dx analyser.

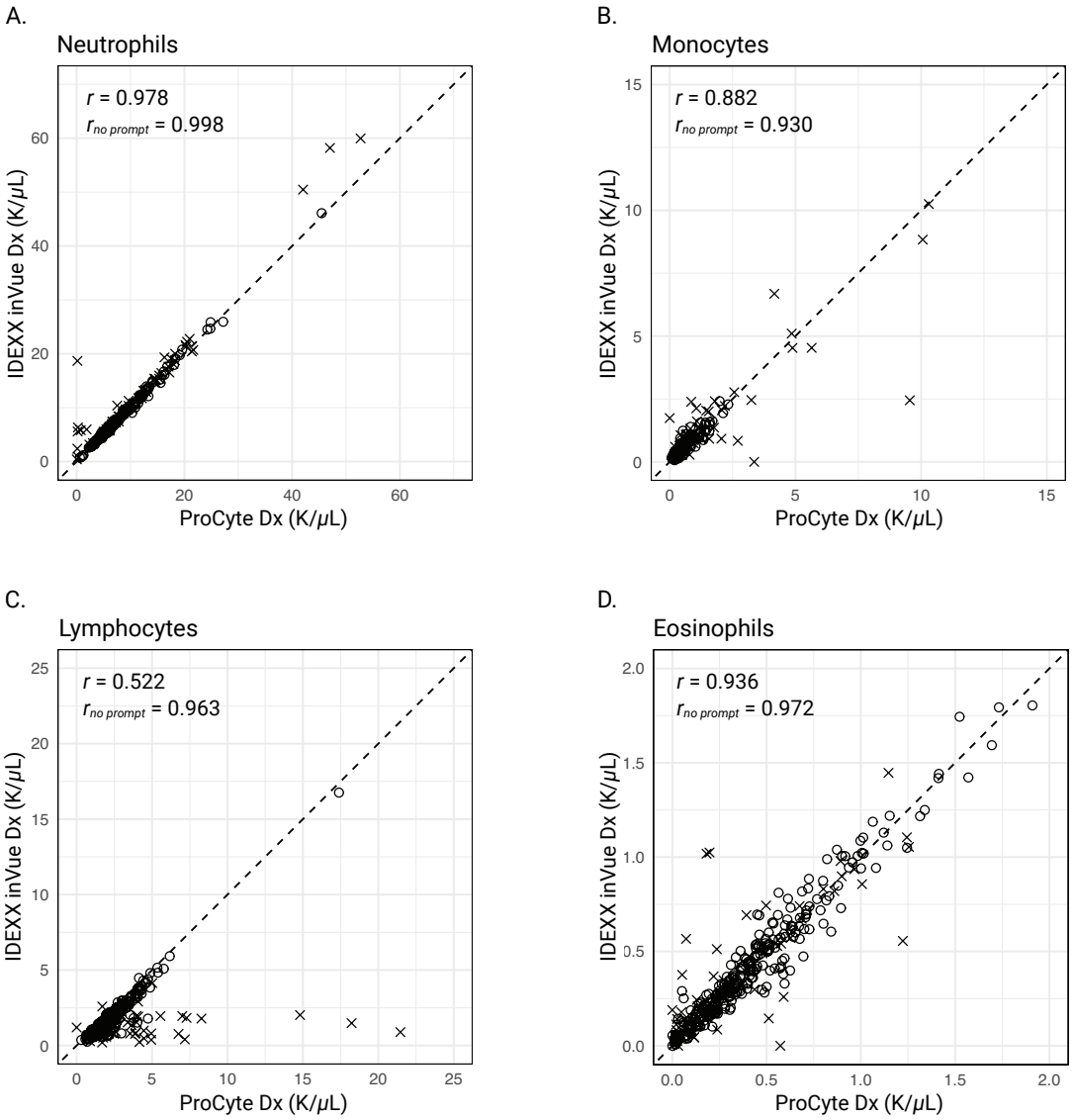

Figure 1. Correlation plots for the IDEXX inVue Dx and ProCyte Dx analysers' differential counts for neutrophils (A), monocytes (B), lymphocytes (C) and eosinophils (D). The dotted line indicates the identity line if the ProCyte Dx and IDEXX inVue Dx counts match exactly. 'X' indicates cases where there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

There was excellent correlation between platelet counts between automated methods when either including (r = 0.940) or removing (r = 0.937) samples with 'platelet clumping' interpretive prompts on the ProCyte Dx* analyser from analysis (Figure 2A). Semi-quantitative platelet assessment also showed excellent correlation between methods (Kendall tau-b = 0.720, Figure 2B).

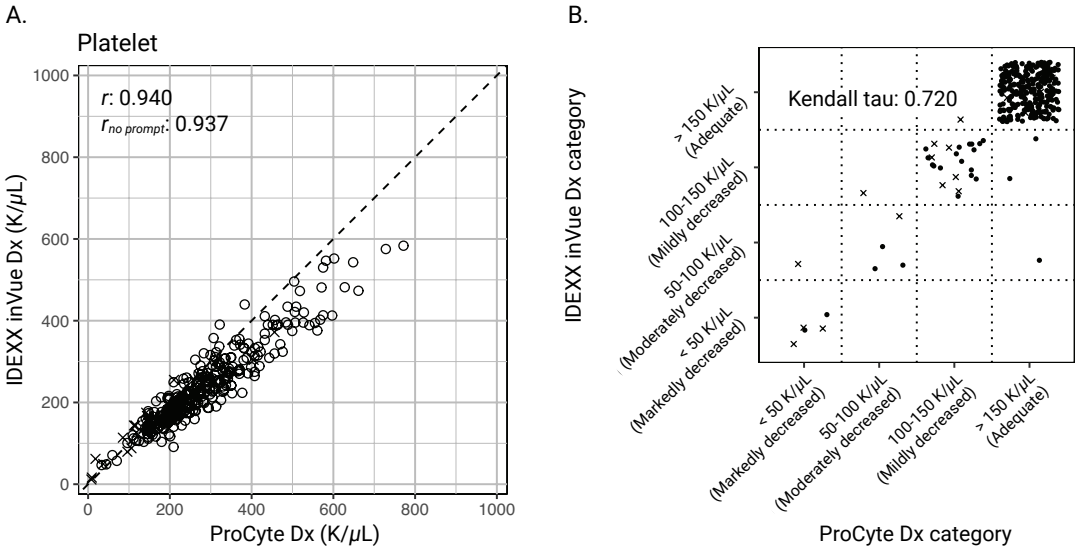

Figure 2. Correlation between the IDEXX inVue Dx and ProCyte Dx analysers for discrete (A) and semi-quantitative (B) platelet reporting. The ProCyte Dx analyser runs with an interpretive prompt indicating that platelet clumps are marked by an 'X'.

The IDEXX inVue Dx analyser performance compared to pathologist manual WBC differentials

Six-part WBC differential

The IDEXX inVue Dx* analyser provides updated WBC differentials if the analyser detects a clinically significant change in cell counts from the CBC, such as when immature neutrophils are present. To evaluate the ability of the IDEXX inVue Dx analyser to update WBC differentials, the 348 samples described above underwent pathologist blood film review, and of these, 75 samples had immature neutrophils. Samples were stained with modified Wright-Giemsa stain (Aerospray* 7120 Haematology Slide Stainer/Cytocentrifuge) and scanned on a digital slide scanner (MoticEasyScan* One, software version 1.0.7.50 or 1.0.6.49). The IDEXX inVue Dx analyser was compared to traditional blood films by calculating the average of manual six-part, 200-cell WBC differentials performed by three board-certified pathologists.

Correlation between the IDEXX inVue Dx results and average expert manual 200-cell differentials are shown in Figure 3. Correlation of mature neutrophils, monocytes, lymphocytes, and eosinophils remained very strong (r > 0.90). Manual and IDEXX inVue Dx correlation of immature neutrophils was strong (Figure 3E), substantiating that automated blood morphology analysis from the IDEXX inVue Dx analyser performs well in updating the WBC differential in cases of left shift.

Conclusion

The IDEXX inVue Dx analyser performs automated, slide-free blood morphology analysis in dogs by utilising computational power and deep-learning models to produce accurate, algorithm-assisted pathology results. The platform adds significant value by automating the interpretation of blood morphology, and it demonstrates excellent correlation with the ProCyte Dx CBC results or a pathologist's blood film interpretation when required to assess morphological changes within the blood sample.

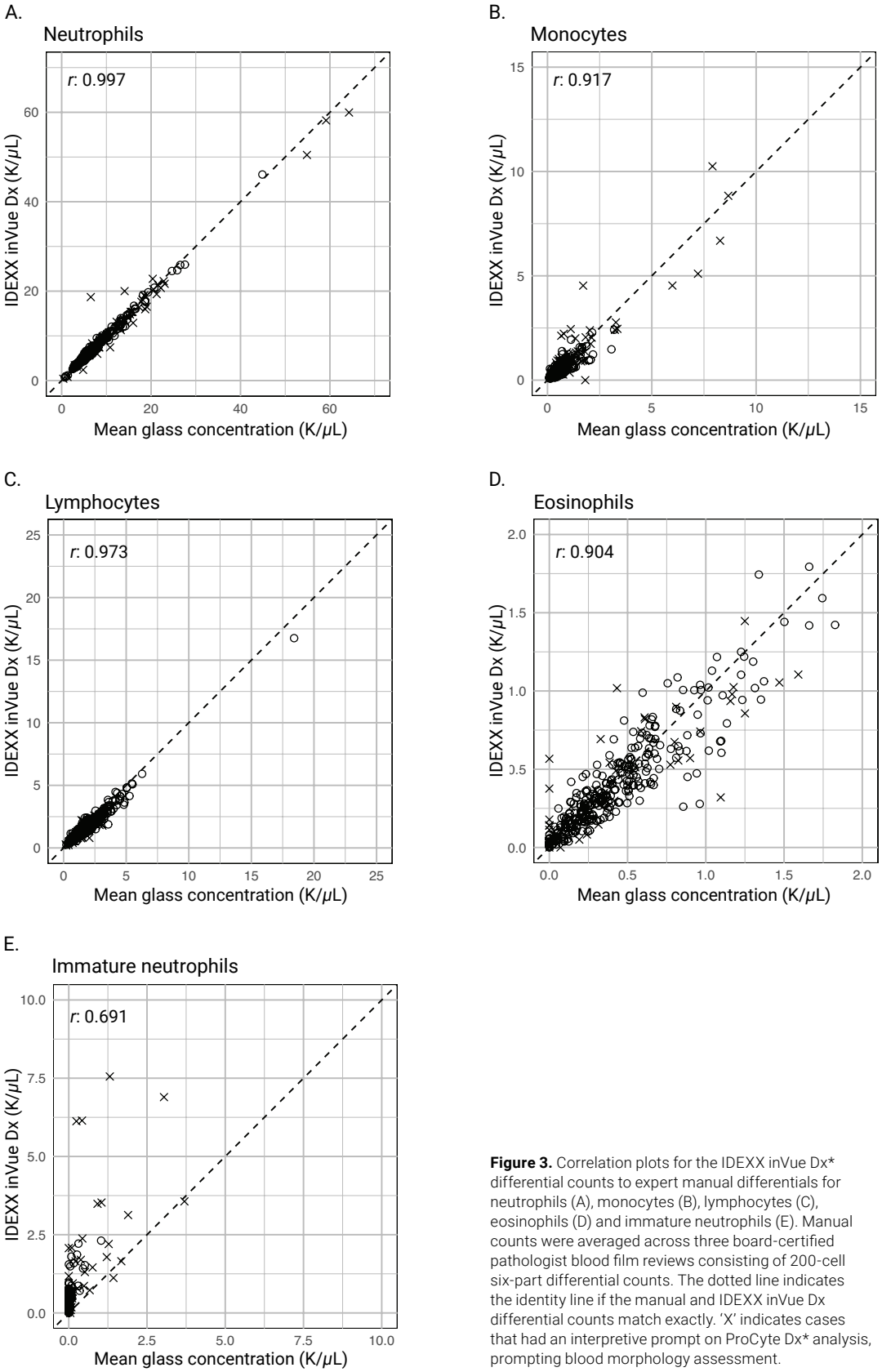

Figure 3. Correlation plots for the IDEXX inVue Dx* differential counts to expert manual differentials for neutrophils (A), monocytes (B), lymphocytes (C), eosinophils (D) and immature neutrophils (E). Manual counts were averaged across three board-certified pathologist blood film reviews consisting of 200-cell six-part differential counts. The dotted line indicates the identity line if the manual and IDEXX inVue Dx differential counts match exactly. 'X' indicates cases that had an interpretive prompt on ProCyte Dx* analysis, prompting blood morphology assessment.

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