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A Comparison of Mindray BC-6800, Sysmex XN-2000, and Beckman Coulter LH750 Automated Hematology Analyzers: A Pediatric Study

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Background: Modern automated laboratory hematology analyzers allow the measurement of over 30 different hematological parameters useful in the diagnostic and clinical interpretation of patient symptoms. They use different methods to measure the same parameters. Thus, a comparison of complete blood count made by Mindray BC-6800, Sysmex XN-2000 and Beckman Coulter LH750 was performed. *Materials and methods:* A comparison of results obtained by automated analysis of 807 anticoagulated blood samples from children and 125 manual microscopic differentiations were performed. This comparative study included white blood cell count, red blood cell count, and erythrocyte indices, as well as platelet count. *Results:* The present study showed a poor level of agreement between white blood cell enumeration and differentiation of the three automated hematology analyzers under comparison. A very good agreement was found when comparing manual blood smear and automated granulocytes, monocytes, and lymphocytes differentiation. Red blood cell evaluation showed better agreement than white blood cells between the studied analyzers. *Conclusion:* To conclude, studied instruments did not ensure satisfactory interchangeability and did not facilitate a substitution of one analyzer by another. J. Clin. Lab. Anal. 00:1–7, 2016. © 2016 Wiley Periodicals, Inc.

Key words: automated hematology analyzer; comparison; complete blood count; pediatric hematology

INTRODUCTION

Complete blood count (CBC) analysis is performed for the analysis of abnormalities within the white blood cells (WBC), red blood cells (RBC), and platelets (PLT) of peripheral blood. Modern automated laboratory hematology analyzers allow the measurement of over 30 different hematological parameters useful in the diagnostic and clinical interpretation of patient symptoms (1–3). Even though automated analyzers use the most advanced technologies for the performance of white blood cell differentiation, manual microscopy remains the most reliable and reference method for WBC evaluation, when performed by an expert microscopist (4). Manual, light-microscopic blood smear analysis is time-consuming and the interpretation of results depends on the number of cells included in the analysis as well as on the experience of the laboratory diagnostician (5). Thus, basing interpretation on analysis performed with automated analyzers, which can test over 1000 specimens per day, would be very useful, provided that results obtained from those instruments were reliable and comparable between analyzers used in different laboratories.

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Comparative analyses of different automated hematology analyzers have previously been performed, and these have indicated variable differences in assaying either peripheral blood samples or body fluid specimens (1–3, 6–20).

In the present study, we compared three different hematology analyzers: Mindray BC-6800, Sysmex XN-2000 and Beckman Coulter LH750. Two of these used light scattering and the analysis of fluorescence for the determination of all studied hematological parameters. In LH750, examination is based on the impedance method, conductivity, and staining with non-fluorescent dye in the analysis of the reticulocyte fraction. All analyses were performed on pediatric specimens with different abnormalities within WBC, RBC, and PLT. Analysis was extended by a manual microscopy blood smear examination performed for referred specimens.

MATERIALS AND METHODS

Specimens

For the comparative study, a total of 807 K_3EDTA anticoagulated peripheral blood samples from children aged 1 day–18 years, either boys or girls, collected in 1-ml tubes (Medlab Products, Raszyn, Poland) were selected. All samples were used for routine hematological analysis at Laboratory I—using a Beckman Coulter LH750 analyzer, and Laboratory II—using a Sysmex XN-2000 belonging to the Warsaw Public Pediatric Hospital, at the Department of Laboratory Diagnostics and Clinical Immunology of Developmental Age, Medical University of Warsaw. Additional analyses with the other two automated analyzers (Sysmex XN-2000 and Mindray BC-6800 or Beckman Coulter and Mindray BC-6800, respectively) were performed when all routine tests had been completed. Secondary analyses for each sample were performed within 2 h of the diagnostic test, specimens were transported between laboratories at room temperature—time of transport was shorter than 15 min. Samples included normal as well as pathological specimens from patients suffering from hematological diseases (leukemia, lymphoma, Hodgkin's disease, anemia of different etiology, thrombocytopenia, thrombocytosis, hemoglobinopathies), acute and chronic inflammation, other oncological diseases (i.e., neuroblastoma), kidney disease (nephrotic syndrome, hemolytic uremic syndrome), allergies, gastrointestinal diseases (Crohn disease, celiac disease), endocrinological disorders and others. The studied samples were obtained from children hospitalized in different hospital departments or being routinely examined within ambulatory consultations. Collection of samples last for 3 months. The number of analyzed samples were different for the analyzers being compared—the possibility of specimen analysis depended on its primary volume and other tests referred from the same sample (e.g., osmotic fragility, eosin-5'-maleimide binding test, two or more manual smears). Table 1 presents the number of samples analyzed in each arrangement.

Instruments

The Mindray BC-6800 (Mindray Bio-Medical Electronics Co., Ltd, Shenzhen, China) provides classification of white blood cells based on the size of cells, their granularity, and content of nucleic acid. Nucleated red blood cells (NRBC) are counted separately and basophils are counted in selected channels. The fluorescent stain allows the differentiation of reticulocytes (RET) on various levels of maturation. The equipment enables the measurement of hemoglobin concentrations in reticulocytes (RetHgb) and mean reticulocyte volume (MRV). The instrument provides the measurement of 54 different diagnostic and research parameters. The throughput is 125 tests per hour in CBC+Diff mode, and 90 tests per hour in CBC+Diff+RET mode. Sample volume needed for analysis is 200 µl in automated mode and 150 µl in manual mode. The instrument allows the analysis of capillary blood at a volume of 40 µl per sample.

The Sysmex XN-2000 (Sysmex, Kobe, Japan) analyzes complete blood count based on laser light scattering (forward and light scatter) and side fluorescent light. It possesses channels for white precursor cells, which allows the counting of immature granulocytes (IMG) and atypical lymphocytes. Nuclei of NRBCs

TABLE 1. The Numbers of Samples Analyzed for each Analyzer

Number of analyzed samples for parameters	Sysmex XN2100 vs. Mindray BC6800	Sysmex XN2100 vs. Beckman Coulter LH750	Mindray BC6800 vs. Beckman Coulter LH750
Basophils, eosinophils, lymphocytes, Monocytes, Neutrophils, WBC	798	398	391
Hct, Hgb, MCV, RBC, RDW	803	401	398
Hgb/ ret	503	–	–
IG	802	–	–
Ret, IRF	503	52	46
NRBC	798	382	380
PLT	807	404	404

are counted based on fluorescence and side light scatter. Reticulocyte mode allows the measurement of reticulocyte hemoglobin equivalents and immature reticulocyte fractions (IRF). The XN-2000 allows the measurement of 44 diagnostic parameters, 16 of which are optional. The throughput is up to 200 tests per hour and the aspiration volume of samples is 88 µl in all modes.

The Beckman Coulter LH750 (Beckman Coulter, Miami, Florida) uses the impedance method to measure cell size and complexity. Reticulocyte measurement is based on non-fluorescent dye which stains residual RNA within red blood cells. The LH750 measures 30 different diagnostic and research parameters. The throughput is up to 110 samples per hour, sample volume needed for analysis is 200 µl in manual mode and 330 µl in automated mode.

As a piece of laboratory equipment used routinely in laboratory practice, the hematology analyzers were regularly controlled by external and internal laboratory control programs.

Blood Smear Analysis

Peripheral blood smears were performed manually by one specialized laboratory technician to avoid a human error in the context of discrepancies in slide interpretation due to different smear technique. All slides were subsequently manually stained with May–Gruenwald–Giemsa staining by the same technician. Each blood sample and slide was coded with a unique numerical identifier which provides patients with anonymity and simultaneously allows the comparison of examination results. Differentiation of white blood cells on smears was performed by three specialized diagnosticians on 400 cells (leukopenia samples—WBC< 2×10^9/l—were analyzed up to 100 cells if possible).

Statistical Analysis

Statistical analysis was performed with Microsoft Excel (Microsoft Corporation, Redmond, WA) and MedCalc Software, Ostend, Belgium. A degree of agreement between the same parameters analyzed with two hematology analyzers was evaluated using the nonparametric Passing and Bablok regression method. A P value <0.05 was considered to be statistically significant for every analysis.

RESULTS

White blood cell counts in specimens for which an automated analyzer showed a reliable differentiation of leukocytes were recognized as the limit of detection for studied laboratory equipment. The limit of detection of platelet count was recognized for PLT values with other platelet parameters such as MPV (mean platelets volume) and PCT (platelet hematocrit). The lowest WBC values detected by each analyzer were: 0.11×10^9/l for BC6800, 0.1×10^9/l for LH750, and 0.04×10^9/l for XN2000. Platelet numbers were presented by the instrument if PLT $\geq 9 \times 10^9$/l for BC6800, PLT $\geq 3 \times 10^9$/l for LH750, and PLT $>11 \times 10^9$/l for XN2000.

The Passing and Bablok regression analysis for agreement between the two different analyzers showed poor agreement for most studied parameters. Tables 2–4 present exact equations and 95% confidence intervals for slope and intercept for all arrangements.

There were no parameters whose results were similar for all three analyzers—there were no parameters for

TABLE 2. A Passing–Bablok Regression Analysis for BC600 and LH750 Comparison. Number of Analyzed Samples are Specified in Table 1. Shading Indicate Statistical Significance (Slope CIs do not Include 1.0 or Intercept CIs do not Include 0)

	BC6800 and LH750		
	Equation	95% CI for intercept	95% CI for slope
WBC	$y = 0.007 + 1.0131\ x$	−0.025 to 0.037	1.007 to 1.019
Neutrophils	$y = -0.078 + 1.011\ x$	−0.103 to −0.060	1.000 to 1.020
Lymphocytes	$y = 0.019 + 1.001\ x$	−0.001 to 0.033	0.996 to 1.009
Monocytes	$y = -0.012 + 1.250\ x$	−0.012 to 0.000	1.208 to 1.250
Eosinophils	$y = -0.010 + 0.968\ x$	−0.010 to −0.009	0.952 to 1.000
Basophils	$y = 0.000 + 0.000\ x$	−0.006 to 0.000	0.000 to 0.556
RBC	$y = -0.051 + 1.043\ x$	−0.085 to −0.021	1.035 to 1.052
Hemoglobin	$y = 0.160 + 0.979\ x$	−0.100 to 0.2606	0.970 to 1.000
Hematocrit	$y = -1.200 + 1.051\ x$	−1.694 to −0.720	1.037 to 1.066
MCV	$y = 1.577 + 0.966\ x$	0.104 to 2.956	0.949 to 0.984
RDW	$y = -1.973 + 1.176\ x$	−2.320 to −1.635	1.154 to 1.200
NRBC	$y = 0.000 + 0.000\ x$	0.000 to 0.000	0.000 to 1.186
Ret	$y = 0.003 + 1.005\ x$	−0.001 to 0.009	0.932 to 1.101
PLT	$y = 3.921 + 0.921\ x$	2.475 to 5.778	0.910 to 0.932

TABLE 3. A Passing–Bablok Regression Analysis for BC600 and XN2100 Comparison. Number of Analyzed Samples are Specified in Table 1. Shading Indicate Statistical Significance (Slope CIs do not Include 1.0 or Intercept CIs do not Include 0)

	BC6800 and XN2100		
	Equation	95% CI for intercept	95% CI for slope
WBC	$y = 0.016 + 1.008\ x$	−0.012 to 0.040	1.003 to 1.013
Neutrophils	$y = 0.098 + 1.039\ x$	0.086 to 0.112	1.033 to 1.045
Lymphocytes	$y = -0.000 + 0.984\ x$	−0.012 to 0.012	0.980 to 0.989
Monocytes	$y = -0.014 + 0.872\ x$	−0.021 to −0.009	0.862 to 0.882
Eosinophils	$y = 0.005 + 1.030\ x$	0.001 to 0.008	1.013 to 1.043
Basophils	$y = 0.002 + 0.750\ x$	0.000 to 0.003	0.714 to 0.800
RBC	$0.227 + 0.892\ x$	0.189 to 0.268	0.882 to 0.901
Hemoglobin	$y = 0.192 + 0.980\ x$	0.000 to 0.303	0.971 to 1.000
Hematocrit	$y = 1.608 + 0.916\ x$	1.150 to 2.062	0.903 to 0.929
MCV	$y = -2.774 + 1.053\ x$	−3.690 to −1.862	1.042 to 1.064
RDW	$y = 0.351 + 0.976\ x$	0.000 to 0.783	0.944 to 1.000
NRBC	$y = 0.000 + 0.000\ x$	0.000 to 0.000	0.000 to 0.000
Ret	$y = 0.001 + 0.759\ x$	−0.000 to 0.002	0.735 to 0.784
PLT	$y = -1.753 + 1.041\ x$	−3.950 to 0.212	1.032 to 1.050

TABLE 4. A Passing–Bablok Regression Analysis for LH750 and XN2100 Comparison. Number of Analyzed Samples are Specified in Table 1. Shading Indicate Statistical Significance (Slope CIs do not Include 1.0 or Intercept CIs do not Include 0)

	LH750 and *X*N2100		
	Equation	95% CI for intercept	95% CI for slope
WBC	$y = 0.036 + 1.018\ x$	0.004 to 0.075	1.011 to 1.024
Neutrophils	$y = 0.007 + 1.048\ x$	−0.009 to 0.023	1.040 to 1.057
Lymphocytes	$y = 0.022 + 0.989\ x$	0.010 to 0.041	0.981 to 0.996
Monocytes	$y = -0.021 + 1.056\ x$	−0.034 to −0.010	1.034 to 1.083
Eosinophils	$y = 0.000 + 1.000\ x$	−0.005 to 0.000	1.000 to 1.026
Basophils	$y = 0.000 + 0.000\ x$	−0.005 to 0.000	0.000 to 0.476
RBC	$y = 0.144 + 0.939\ x$	0.103 to 0.185	0.929 to 0.950
Hemoglobin	$y = 0.370 + 0.963\ x$	0.257 to 0.490	0.952 to 0.973
Hematocrit	$y = 0.876 + 0.949\ x$	0.275 to 1.517	0.930 to 0.969
MCV	$y = -1.854 + 1.026\ x$	−3.849 to 0.200	1.000 to 1.051
RDW	$y = -1.632 + 1.162\ x$	−2.180 to −1.137	1.125 to 1.200
NRBC	$y = 0.000 + 0.000\ x$	0.000 to 0.000	0.000 to 0.000
Ret	$y = -0.002 + 0.950\ x$	−0.010 to 0.004	0.881 to 1.076
PLT	$y = 1.880 + 0.967\ x$	−0.055 to 3.733	0.955 to 0.978

which in every arrangement, slope CIs included 1.0 or intercept CIs included 0. We found disagreement in hemoglobin measurement only between Sysmex and Beckman Coulter. Thus, it has been chosen as an example for presenting statistical significance. A *P* value for hemoglobin measurement, whose results were comparable between BC6800 and LH750, BC6800, and XN2100 but not between LH750 and XN2100 were 0.05, 0.02, and 0.26, respectively. Studied laboratory equipment showed no interchangeability. On the other hand results for analysis of comparison between manual blood smear examination and automated analyzers showed good agreement.

For BC6800 vs. LH750 agreement between measurement was found for lymphocytes, hemoglobin, NRBC and reticulocytes (Table 2). No interchangeability was found when measuring other hematological parameters.

For BC6800 and XN2000, only RDW and hemoglobin had slope CIs that included 1.0 or intercept CIs that included 0, which indicated no statistically significant difference between analyzers. (Table 3).

XN2000 and LH750 showed agreement in eosinophils, RDW, and reticulocytes count. No interchangeability was indicated when measuring other parameters (Table 4).

Comparison of manual blood smear analyses and automated white blood cell counts and differentiation showed very good agreement in terms of every parameter. Interestingly, the examined analyzers presented variation in their agreement between lymphocytes and atypical lymphocytes, compared with the reference manual method. Results of the Passing and Bablok regression showed that LH750 does not include atypical lymphocytes as lymphocytes, 95% CI for slope did not contain 1, which showed statistically significant difference. Due to the low count of eosinophils and basophils in blood smears, those parameters were not included in the regression analysis (Table 5).

TABLE 5. A Passing–Bablok Regression Analysis for Examined Automated Analyzers and Manual Smear Analysis Comparison of White Blood Cells Enumeration. Number of Analyzed Samples are Specified in Table 1. Shading Indicate Statistical Significance (Slope CIs do not Include 1.0 or Intercept CIs do not Include 0)

	Equation	95% CI for intercept	95% CI for slope
	Mindray BC6800 vs. manual smear		
Neutrophils	$y = -3.338 + 1.024\ x$	−5.891 to 0.233	0.961 to 1.085
Lymphocytes	$y = 1.468 + 0.964\ x$	−0.483 to 3.725	0.904 to 1.033
Lymphocytes+atypical	$y = 1.717 + 0.933\ x$	−1.250 to 4.050	0.871 to 1.000
Monocytes	$y = 1.788 + 0.868\ x$	−0.250 to 3.175	0.675 to 1.150
Monocytes+atypical	$y = 1.082 + 0.773\ x$	−1.000 to 3.006	0.619 to 1.000
	Sysmex XN2100 vs. manual smear		
Neutrophils	$y = 0.172 + 0.997\ x$	−1.899 to 2.630	0.948 to 1.051
Lymphocytes	$y = -1.638 + 1.019\ x$	−4.636 to 0.940	0.940 to 1.091
Lymphocytes+atypical	$y = -2.006 + 1.056\ x$	−5.519 to 0.487	0.986 to 1.132
Monocytes	$y = -1.888 + 0.918\ x$	−4.151 to 0.088	0.735 to 1.184
Monocytes+atypical	$y = -0.690 + 1.034\ x$	−4.079 to 1.081	0.811 to 1.316
	Beckman Coulter LH750 vs. manual smear		
Neutrophils	$y = -0.128 + 1.005\ x$	−3.035 to 2.054	0.946 to 1.080
Lymphocytes	$y = 1.980 + 0.960\ x$	0.021 to 4.159	0.903 to 1.021
Lymphocytes+atypical	$y = 2.517 + 0.927\ x$	−0.400 to 4.942	0.859 to 0.996
Monocytes	$y = 0.700 + 1.162\ x$	−2.200 to 3.320	0.860 to 1.600
Monocytes+atypical	$y = 0.615 + 0.992\ x$	−2.750 to 2.420	0.808 to 1.350

DISCUSSION

The results of analyses performed by an automated hematology analyzer should be as reliable as possible for every type of sample, including specimens with leucopenia, thrombocytopenia, or anemia. Based on the results obtained for white blood cell differentiation and the presence of pathologies of either red blood cells or platelets, a decision is made regarding manual microscopic peripheral blood analysis. Therefore, the information from a hematology analyzer should leave no doubts, since manual verification of the obtained result is labor-intensive and time-consuming (11). In this study, we evaluated the agreement of CBC results obtained from three different automated analyzers which use their own principles in the differentiation of leukocytes and red blood cells at different stages of maturation. The Mindray BC-6800 and Sysmex XN-2000 use fluorescence and light scattering, and the Beckman Coulter LH750 uses impedance, conductivity and non-fluorescent dye staining. Both BC-6800 and XN-2000 apply flow cytometric methods, although using different reagents for red blood cell lysis and white blood cell differentials. No comparison of all three analyzers has been made so far.

In this study, results of white blood cell counts showed poor agreement between the three studied analyzers. Different results have been shown when comparing other automated hematology analyzers (Abbot Sapphire, Siemens Advia 120, Beckman Coulter DxH800 and Sysmex XE-2100) (15). Good agreement for eosinophil count between LH750 and XN2100 might be explained by bright autofluorescence and specific localization in scattergrams, which makes these cells easy to differentiate from others (15). We did not compare manual and automated eosinophil count, due to low number of cells included in the manual smear examination. However, other researchers did. Meintker et al. suggest that lower eosinophil counts in manual smears are caused by degranulated eosinophils being erroneously counted as neutrophils (15). We cannot agree with this hypothesis, since characteristically stained eosinophil granules are extremely difficult to misclassify. A more probable explanation might be the increased ratio of eosinophil damage during blood smear preparation in comparison with other WBC. Therefore, the lower number of eosinophils in manual examinations compared with automated methods would result from excluding broken cells from the microscopic enumeration. Monocyte count did not show satisfactory agreement between studied analyzers. Other papers showed good repeatability in automated monocytes count (1, 15, 18). On the other hand, monocyte count showed very good agreement between automated analyzers and manual examination: higher than in some other studies (7, 10, 17) and lower than in others (3, 11). It is noteworthy that automated counts of lymphocytes by LH750 show higher agreement when compared with lymphocytes alone, compared with lymphocytes counted together with atypical lymphocytes in manual examination. This suggests that some atypical lymphocytes might be classified as monocytes in hematology analyzers.

Basophil count agreement was low between all three studied analyzers. A similarly poor level of agreement

was indicated by Tan et al. (18). That the smallest level of agreement between different analyzers was in terms of basophil count was also indicated by Meintker et al. (15), where this was explained by a falsely increased basophil count in the presence of atypical lymphocytes and blasts. The reason for the weak agreement for both configurations with LH7500 might be associated with the fact that the Beckman Coulter only presents results with decimal numbers. Basophil count, for which reference values are less than 0.5×10^9/l, are cells with rather low importance. Not till the basophil count increases significantly, which may be indicative for allergies or falsely gated blasts, is their number not clinically relevant. Surprisingly, a high level of agreement for basophils count between BC-6800 and manual microscopy was indicated by Lippi et al. (3), which is not likely to occur in similar studies. To conclude the analysis of white blood cell count, our results are not comparable with others showing low level of agreement between studied laboratory equipment, when other studies show high levels of agreement for neutrophils and eosinophils, moderate for monocytes and low for basophils in comparisons of different automated hematology analyzers (18).

The current study also included an analysis of platelet count, which showed surprisingly low levels of agreement for all instruments. Because we did not compare manual and automated platelet count it cannot be stated that our result is contrary to observations made by other researchers (14–16), that measurement of PLT with modern hematology analyzers is reliable. It can just be concluded that results from studied analyzers could not be used interchangeably.

The results of this investigation show the overall poorly moderate agreement of red blood cell and reticulocyte counts between all three hematology analyzers. Red blood cell distribution width was comparable only for BC6800 and XN2100. Lippi et al. also showed limited comparability of RDW results between different hematology equipment. This is explained by the different approaches used for evaluating the anisocytosis index across automated analyzers (12). The same group showed high agreement in MCV measurements between the examined analyzers (12), which was confirmed by us only for LH750 and XN2100. Here, we observed high agreement for hemoglobin values for BC-6800 vs. LH750 and BC6800 vs. XN2100. Similarly, Jo et al. showed substantially higher agreement for this parameter between BC-6800 and LH750 (10) and Meintker et al. indicated extremely good accordance for hemoglobin concentration measured with Sapphire, Advia 120, XE-2100 and DxH 800 (15).

Reticulocyte count is applied as an indicator of effective erythropoiesis within bone marrow (13, 20). Reticulocyte count showed satisfactory agreement between the studied analyzers, the lowest for BC-6800 and XN-2000. Both BC-6800 and XN-2000 employ fluorescent dyes, whereas LH750 uses non-fluorescent dye for reticulocyte staining. All the examined instruments present immature reticulocyte fractions as well; however, the Beckman Coulter LH750 displays the result of analysis as a specifically calculated index which could not be directly compared with results obtained from Mindray and Sysmex. The agreement in terms of reticulocyte counts between BC-6800 and the other two analyzers was higher than Grillone et al. indicated (8). Furthermore, they showed strong correlation between BC-6800 vs. manual reticulocyte examination ($R = 0.963$) and a slightly lower correlation for LH750 vs. microscopic count ($R = 0.902$) (8). In the present study, the correlation for the obtained results between examined analyzers was even higher than the agreement between two other analyzers which use absorbance (ADVIA2120) and fluorescence (XE-2100) methods (13). Based on our results, it can be suggested that no difference in RET count is found between instruments using fluorescent cyanine dye (BC-6800), fluorescent polymethine dye (XN-2000) or non-fluorescent methylene blue (LH750).

The limitation of our study is that we did not analyze bias for each instrument. Due to small volume of samples, that were analyzed with three different instruments, there was no possibility to repeat analysis with every analyzer one more time. Thus, we cannot analyze the Bland–Altman plots to estimate each analyzer repeatability. However, the main aim of this study was to assess possible interchangeability of studied analyzers and it has been done.

Taken together, the usefulness and capability of the three analyzers were comparable overall. In terms of white blood cells analysis they ensure that convincing numerical data can be obtained when compared with manual smear examination, which suggests that they can be used interchangeably, despite a lack of agreement between them. The crucial factor, which could have a determinant role in deciding about the usage of a specific hematology analyzer in a pediatric hospital laboratory, could be the volume of sample needed for effective analysis. The specimen volumes obtained from newborns, including preterm infants, are limited and the requirements of analyzers regarding necessary blood volume and the abilities to measure hematologic parameters from diluted samples (6) would decide on their usefulness.

Collectively, we can state that results were not transferable between the three studied analyzers. The main conclusion of our study is that samples from one patient should be analyzed with the same laboratory

instrument, because possible changes in hematological parameters, when using different analyzers, could not be noticed and properly interpreted.

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