Performance Comparison of Two Sysmex Hematology Analyzers: the XN-550 and the XS-1000*i*

Qian-Yun ZHANG[*1], Jill CRIST[*2], Tiffany IVERS[*2]

[*1] *Department of Pathology, University of New Mexico & TriCore Reference Laboratories, Albuquerque, NM, USA*

[*2] *Sysmex America, Inc., Lincolnshire, IL, USA*

INTRODUCTION

1. Purpose

Since 2011, Sysmex has been offering the XN-Series of hematology analyzers to support the needs of large clinical laboratories. With the global introduction of the XN-L Series in 2015, similar functionality, operability, and clinical parameters [1,2,3,4] as the XN-Series are now available in a compact, automated, hematology analyzer well-suited for the small to medium-sized lab; for acute care settings; or for use in emerging markets where a larger analyzer may neither be cost-effective nor practical. The XN-L Series is also suitable as a backup analyzer where an XN-Series analyzer is already installed because they share the same user interface, reagents, and control solutions along with the accuracy and linearity compared with the XN-Series that has already been characterized [1,5].

The purpose of this study was to demonstrate that the analytical performance of The Automated Hematology Analyzer XN-550 (XN-550; Sysmex Corporation, Kobe, Japan), one of the XN-L Series analyzers, is comparable to the existing The Automated Hematology Analyzer XS-1000*i* (XS-1000*i*; Sysmex Corporation, Kobe, Japan) desktop analyzer, and to provide additional data demonstrating the precision and linearity of several parameters of the XN-L Series. This study was performed to evaluate the analytical performance of this instrument for the US market.

2. About the XN-L Series of analyzers

The XN-L Series of analyzers uses the proven technologies of flow cytometry [for white blood cells (WBC)], fluorescence flow cytometry [for white blood cell differential (WBC DIFF) and reticulocyte count (RET)], direct current impedance method with hydrodynamic focusing [for red blood cell (RBC) and platelet (PLT)], and cyanide-free SLS (sodium lauryl sulfate) methods [for hemoglobin (HGB)] that are used in the XN-Series and proven to be accurate [6] and reliable. This series offers testing modes including whole blood (WB), low WBC (LWBC), pre-dilute (PD), and body fluid (BF) along with 35 reportable whole blood parameters and seven body fluid parameters as shown in ***Table 1*** [7].

Table 1 *Reportable parameters for the XN-L SeriesTM in the US*

** Indicates optional feature with activated license*

[Whole Blood] mode / [Low WBC] mode* / [Pre-Dilute] mode	
Detector / Channel	Parameter
WDF	WBC, NEUT#, LYMPH#, MONO#, EO#, BASO#, NEUT%, LYMPH%,
RBC/PLT	MONO%, EO%, BASO%, IG#, IG%
	RBC, HCT, MCV, MCH, MCHC, PLT, RDW-SD, RDW-CV, MPV
HGB	HGB
RET	RET%*, RET#*, IRF*, RET-He*
[Body Fluid] mode*	
Detector / Channel	Parameter
WDF	WBC-BF, MN#, MN%, PMN#, PMN%, TC-BF#
RBC/PLT	RBC-BF

Comprised of three main instruments, the XN-L Series offerings differ primarily in automation features and tube handling capabilities. Samples can be run by manual analysis, which requires the medical laboratory scientist to physically hold a single sample up to the aspiration sensor or place it in the analyzer for testing; or by sampler analysis, which involves loading multiple sample tubes into a testing rack which then automatically approach the aspiration sensor for analysis. The Automated Hematology Analyzer XN-350 (XN-350; Sysmex Corporation, Kobe, Japan) accommodates manual analysis with open-tube sampling, while The Automated Hematology Analyzer XN-450 (XN-450; Sysmex Corporation, Kobe, Japan) also uses single sample analysis and, in addition, offers both open-tube sampling and cap-piercing closed sampling functions. The largest and most fully equipped XN-550 comes standard with a continuous-feed autoloader and features automated repeat/rerun/reflex capability. All three instruments include an embedded IPU (information processing unit) with touchscreen display.

The XN-L Series may serve as a replacement for the XS-1000*i*, the Sysmex legacy analyzer. Compared with this analyzer, the XN-L Series offers the following improvements and features including additional parameters and testing modes, onboard rules, and increased storage capability (***Table 2***). Upon comparison of the two instruments notable channel improvements for the XN-L Series include the addition of a reticulocyte (RET) detection channel and an enhanced WDF channel for differential counting.

Table 3 summarizes key features between the XN, XN-L and XS-1000*i* Series of instruments. The XN-L offers enhanced nRBC flagging compared to the XS-1000*i* Series as well as many of the same features as the XN-Series.

Table 2 *Feature comparison of XN-L Series and XS-1000i Series in the US*

XN-L Series	XS-1000*i* Series
Aspiration volume: 25 μL (WB mode)	Aspiration volume: 20 μL (open/closed mode)
WB mode: Up to 60 samples/hour	Single Sample Mode: 60 samples/hour Auto Sampler Mode: 53 samples/hour
6-part differential with IG NEUT, LYMPH, MONO, EO, BASO, IG	5-part differential NEUT, LYMPH, MONO, EO, BASO
Enhanced nRBC flagging	nRBC flagging
RET channel (reticulocyte) license optional at time of purchase	Not available
BF (body fluid mode) license optional at time of purchase	Not available
Low WBC mode	Not available
Onboard Rules: XN-350 - Action message XN-450 - Action message XN-550 - Automatic repeat, rerun, reflex	None
100,000 result storage	10,000 result storage

Table 3 *Feature comparison between XN, XN-L, and XS-1000i Series analyzers*

	XN Series	XN-L Series	XS-1000*i* Series
Immature Granulocyte (IG)	Yes	Yes	Not available
Enumerated nRBC	Yes	Flagging only	Flagging only
Reticulocytes with RET-H_e	Yes	Yes (optional)	Not available
Automatic body fluid testing	Yes	Yes (optional)	Not available
Onboard rules	Yes	Yes	Not available
Repeat/reflex testing	Yes	Yes	Not available
Patient results in browser (#)	100,000	100,000	10,000
Quality Control files (#)	99	99	20

Table 4 lists sample volume requirements for whole blood, pre-diluted blood, and body fluids [8]. Depending on the collection tube chosen, sample volume requirements can be as low as 250 µL for the sampler mode or 100 µL (WB), 140 µL (PD or BF) for manual analysis.

(Table adapted from Hamaguchi Y, Kondo T, Nakai R, Ochi Y, Okazaki T, Uchihashi K, Morikawa T. Introduction of Products: Overview and Features of the Automated Hematology Analyzer XN-L Series. Sysmex Journal International. 2015;25(1))

Table 5 summarizes sample throughput for whole blood, low WBC samples, pre-diluted blood, and body fluids. Depending on the tests run, sample throughput of up to 60 samples per hour is possible.

(Table adapted from Hamaguchi Y, Kondo T, Nakai R, Ochi Y, Okazaki T, Uchihashi K, Morikawa T. Introduction of Products: Overview and Features of the Automated Hematology Analyzer XN-L Series. Sysmex Journal International. 2015;25(1))

Table 4 *Sample volume requirements for XN-L Series*

1. Use diluted blood prepared by diluting 20É L of whole blood 1:7

2. The availability of body fluid analysis function depends on the system configuration

Analysis method	Specimen	Test tube	Cap	Required sample volume	Aspirated sample volume
Sampler analysis	Whole blood	Regular sample tube	Closed	1 mL	25 µL
		Raised bottom tube (RBT) micro collection tube	Closed	250 µL	
Manual analysis	Whole blood	Regular sample tube	Closed	1 mL	25 µL
			Open	300 µL	
		RBT micro collection tube	Closed	250 µL	
		Micro collection tube	Open	100 µL	
	Diluted blood	Regular sample tube	Open	300 µL	70 µL[1]
		Micro collection tube	Open	140 µL	
	Body fluid [2]	Regular sample tube	Closed	1 mL	70 µL
			Open	300 µL	
		Micro collection tube	Closed	140 µL	

Table 5 *Throughput of XN-L for various samples*

1. Throughput depends on the system configuration

2. Availability of functions depends on the system configurations

Analysis mode	Discrete	Throughput
Whole blood	CBC	Approx. 60 samples/hour
	CBC+DIFF	
	CBC+RET [2]	Approx. 35 samples/hour
	CBC+DIFF+RET [2]	
Low WBC [2]	CBC+DIFF	Approx. 55 samples/hour
	CBC+DIFF+RET [2]	Approx. 30 samples/hour
Pre-Dilute	CBC	Approx. 60 samples/hour
	CBC+DIFF	
	CBC+DIFF+RET [2]	Approx. 30 samples/hour
Body fluid [2]	—	Approx. 30 samples/hour

MATERIALS AND METHODS

The instrument performance evaluation comparing the Sysmex XN-550 with the Sysmex XS-1000*i* was conducted at TriCore Reference Laboratories, Albuquerque, NM.

Standard practice protocols and statistical analysis were used to evaluate the analyzers in the following areas:
1. Correlation between the Sysmex XN-550 and the XS-1000*i* analyzers
2. Linearity of the XN-550 results
3. Precision/repeatability of the XN-550 using both pre-dilute and whole blood samples

Both instruments were set up in accordance with industry standards and manufacturer recommendations.

1. Sample preparation

The study was performed using human peripheral whole blood samples collected in K2 EDTA.

Abnormal samples were expected to represent various clinical conditions of platelet, white cell, and red cell dysfunction. Special consideration was given to nRBCs, low platelets and immature or abnormal WBCs (i.e., blasts, bands, immature granulocytes, variant lymphocytes) as well as RBC abnormalities (i.e., fragments, inclusions, or hemoglobinopathies).

Samples were considered normal/negative if they met the following criteria:
a) No clinical evidence of medical disorder known to affect WBC or differential count
b) CBC parameters within normal range
c) Normal serum chemistry values (if available)

2. Testing criteria

1) Correlation between the Sysmex XN-550 and the XS-1000i analyzers

Between 175 and 195 residual whole blood samples were analyzed using all analysis modes on XN-550. The variation in sample size was due to instrument-excluded samples and those excluded manually due to insufficient sample quantity or inadequate mixing.
The same samples were also run on the XS-1000*i* and correlation coefficients were calculated using EP Evaluator software (Data Innovations LLC).

Statistical Analysis

For each of the following tests listed in the table below, sample data was displayed in Passing-Bablok [9] (scatter plots) along with overlaid regression lines. In addition, regression statistics were presented.

2) Linearity of the XN-550

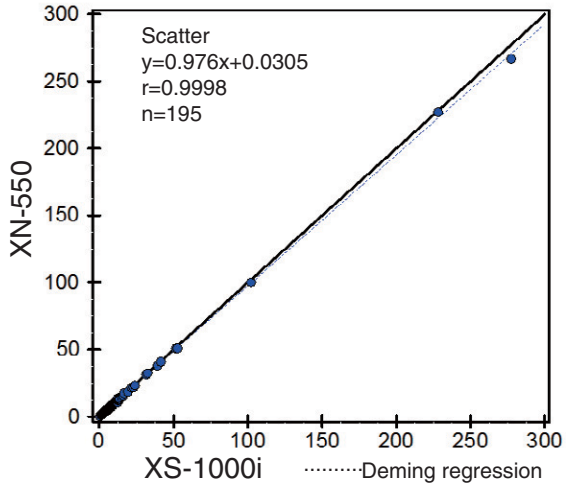
The linearity of a hematology instrument can be verified by comparing the laboratory's reportable range with commercially available linearity assays. RANGE CHECK™ III and RET-CHECK™ II for reticulocytes were used to verify the linearity of the XN-550 throughout its full range.

3) Precision/repeatability of the XN-550 using both pre-dilute and whole blood samples

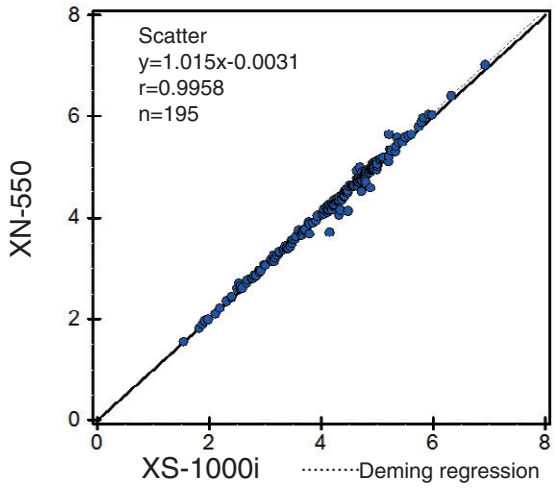
Nine normal whole blood samples from healthy individuals were analyzed in series ten times on the XN-550. Sample analysis was performed within four hours of blood collection. The CV% and SD were calculated.
The same nine samples were diluted (1:7) and analyzed ten consecutive times in the pre-dilute mode on the XN-550. Sample analysis was completed within five hours of blood collection. The CV% and SD were also calculated and compared to data from the whole blood mode.

WBC	White blood cells
RBC	Red blood cells
HGB	Hemoglobin
HCT	Hematocrit
MCV	Mean corpuscular volume
MCH	Mean corpuscular hemoglobin
MCHC	Mean corpuscular hemoglobin concentration
RDWSD	Red cell distribution width — Standard deviation
RDWCV	Red cell distribution width — Coefficient of variation
PLT	Platelets
MPV	Mean platelet volume
NEUT%	Neutrophils, percentage
NEUT#	Neutrophils, absolute
LYMPH%	Lymphocytes, percentage
LYMPH#	Lymphocytes, absolute
MONO%	Monocytes, percentage
MONO#	Monocytes, absolute
EO%	Eosinophils, percentage
EO#	Eosinophils, absolute
BASO%	Basophils, percentage
BASO#	Basophils, absolute

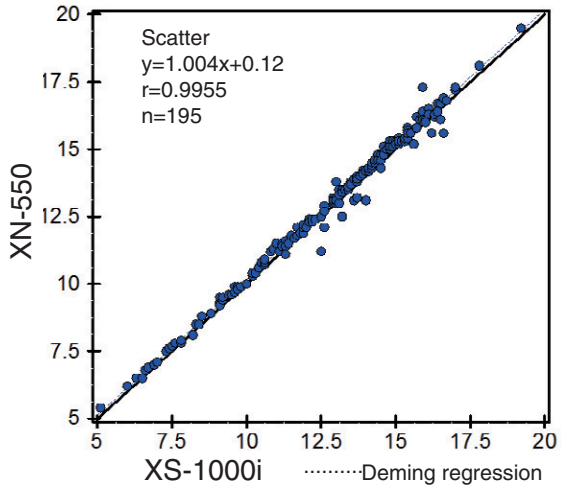
White blood cells, WBC ($10^3/\mu L$)



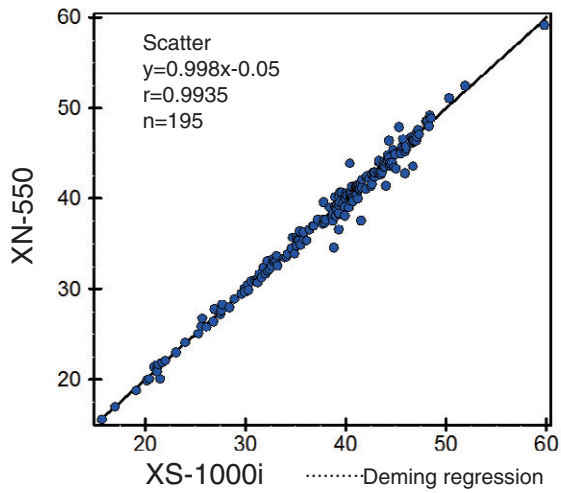
Red blood cells, RBC ($10^6/\mu L$)



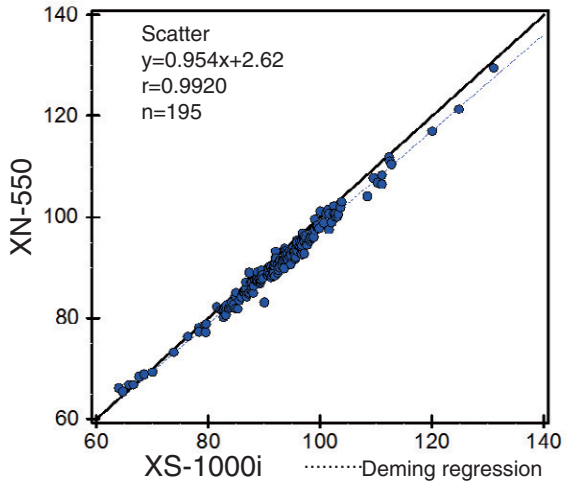
Hemoglobin, HGB (g/dL)



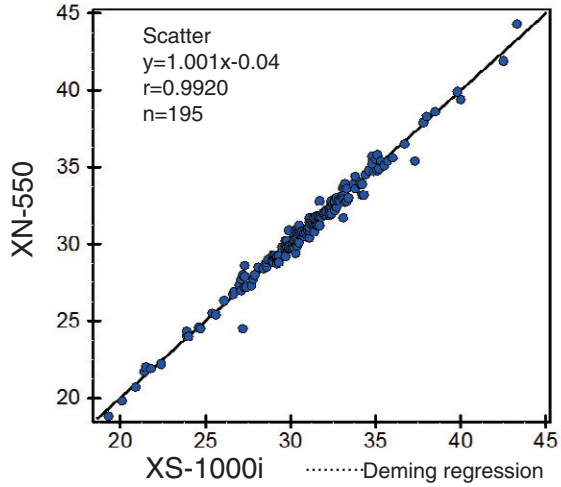
Hematocrit, HCT (%)



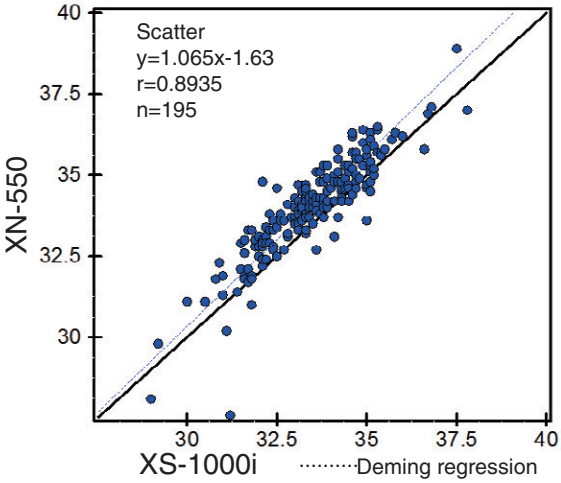
Mean corpuscular volume, MCV (fL)



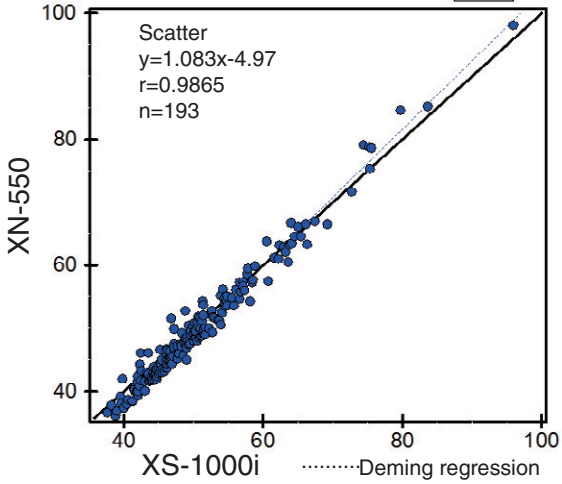
Mean corpuscular hemoglobin, MCH (pg/cell)



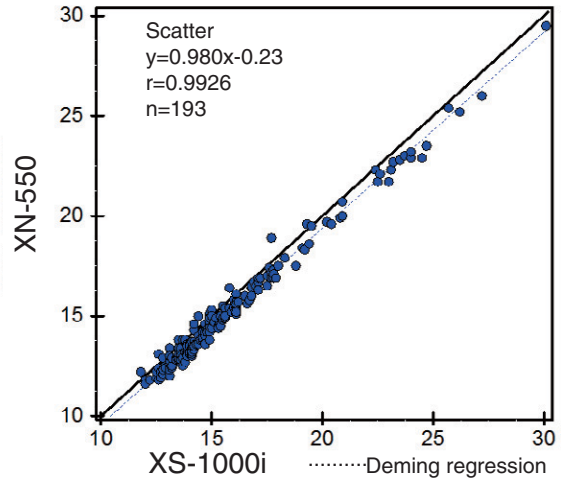
Mean corpuscular hemoglobin concentration, MCHC (g/dL)



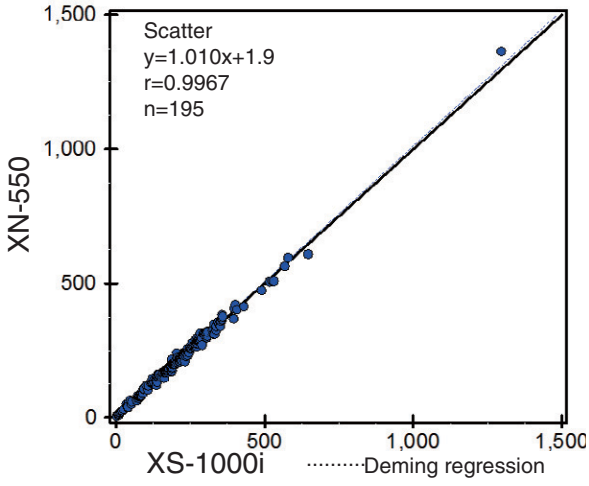
Red cell distribution width-standard deviation, RDW-SD (fL)



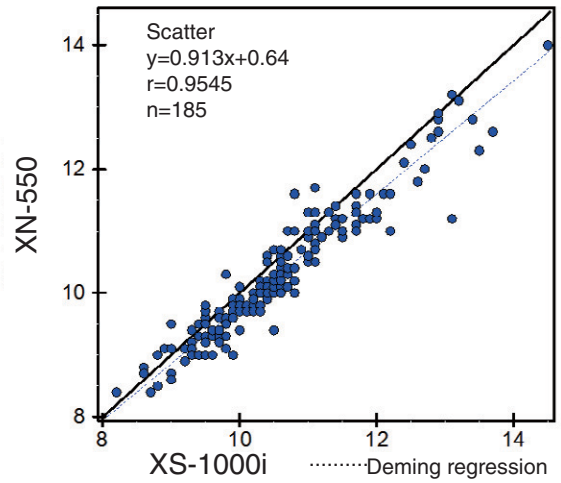
Red cell distribution width-coefficient of variation, RDW-CV (%)



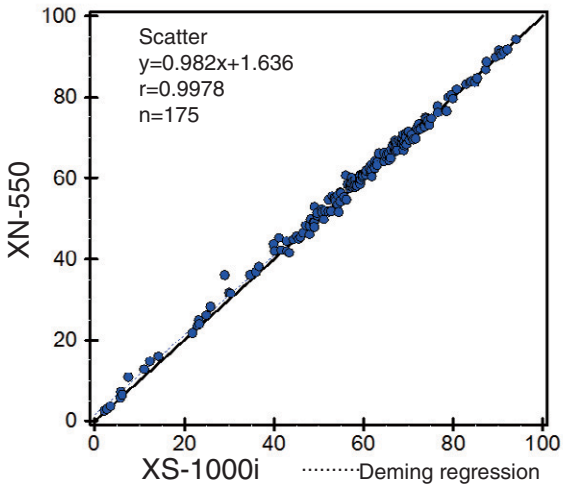
Platelets, PLT ($10^3/\mu L$)

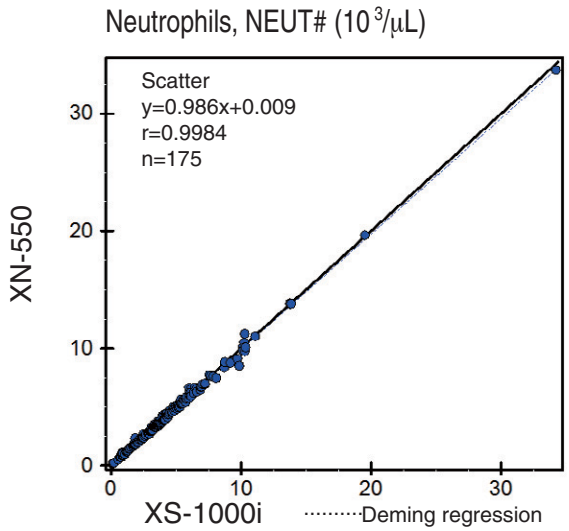


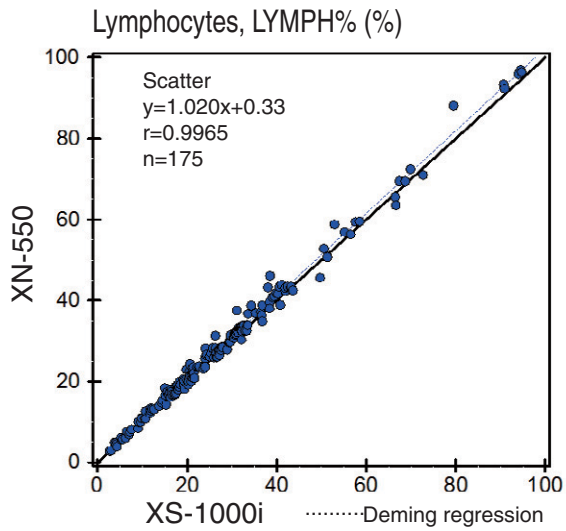
Mean platelet volume, MPV (fL)

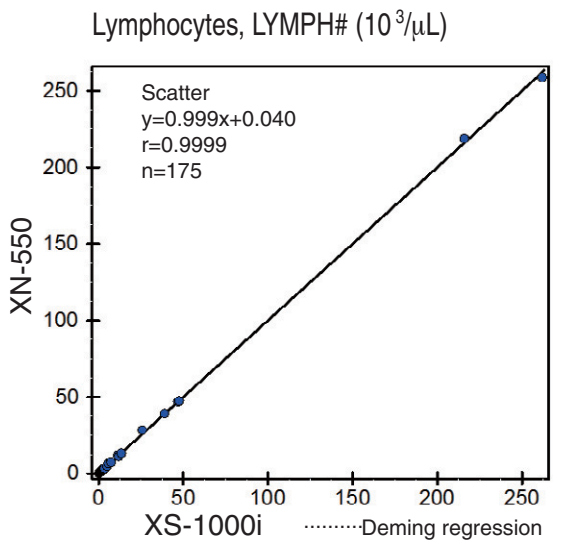


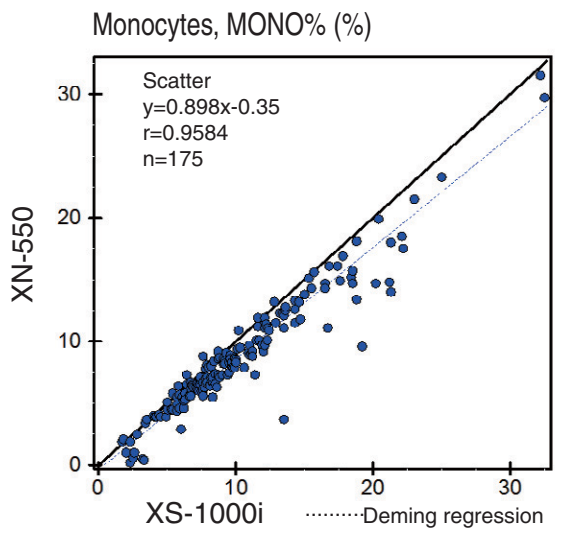
Neutrophils, NEUT% (%)

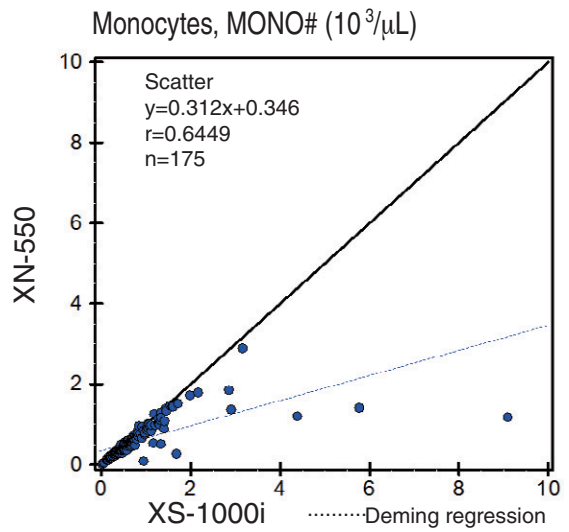


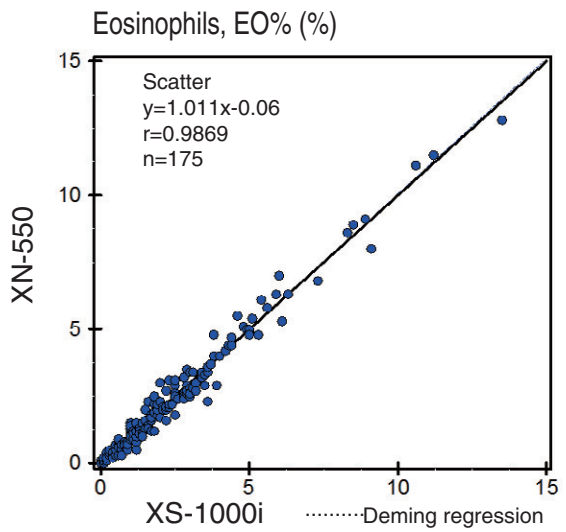

Neutrophils, NEUT# (10 3/μL)
Scatter
y=0.986x+0.009
r=0.9984
n=175
XN-550
XS-1000i
Deming regression

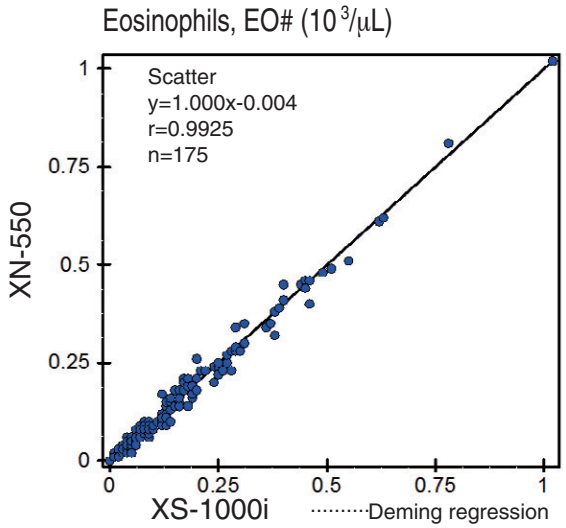

Lymphocytes, LYMPH% (%)
Scatter
y=1.020x+0.33
r=0.9965
n=175
XN-550
XS-1000i
Deming regression

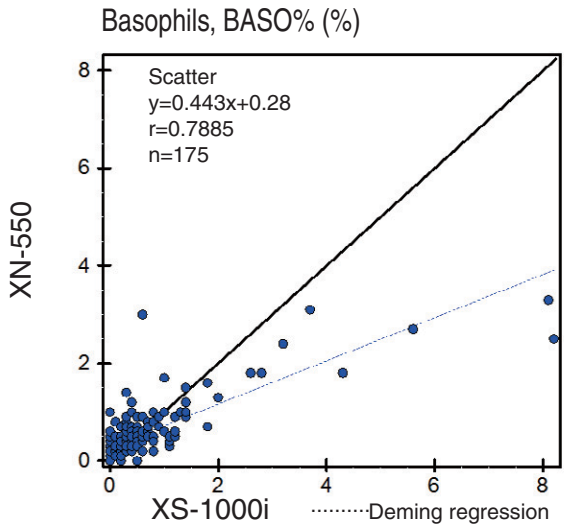

Lymphocytes, LYMPH# (10 3/μL)
Scatter
y=0.999x+0.040
r=0.9999
n=175
XN-550
XS-1000i
Deming regression

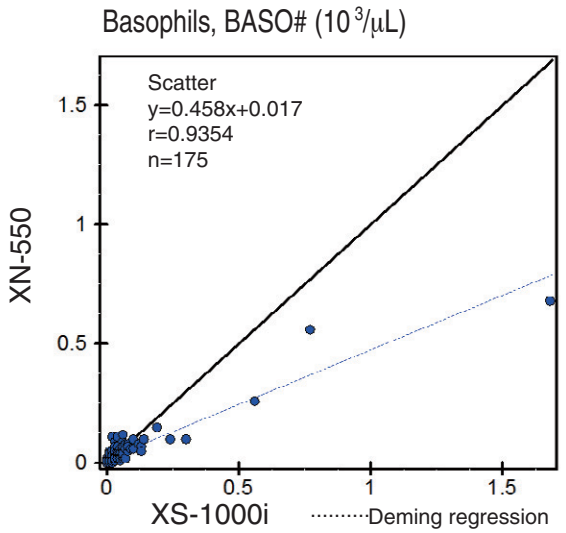

Monocytes, MONO% (%)
Scatter
y=0.898x-0.35
r=0.9584
n=175
XN-550
XS-1000i
Deming regression


Monocytes, MONO# (10 3/μL)
Scatter
y=0.312x+0.346
r=0.6449
n=175
XN-550
XS-1000i
Deming regression


Eosinophils, EO% (%)
Scatter
y=1.011x-0.06
r=0.9869
n=175
XN-550
XS-1000i
Deming regression


Eosinophils, EO# (10 3/μL)
Scatter
y=1.000x-0.004
r=0.9925
n=175
XN-550
XS-1000i
Deming regression
0
0.25
0.5
0.75
1


Basophils, BASO% (%)
Scatter
y=0.443x+0.28
r=0.7885
n=175
XN-550
XS-1000i
Deming regression
0
2
4
6
8


Basophils, BASO# (10 3/μL)
Scatter
y=0.458x+0.017
r=0.9354
n=175
XN-550
XS-1000i
Deming regression
0
0.5
1
1.5

RESULTS

1. Correlation between the Sysmex XN-550 and the XS-1000*i* analyzers

Data was presented using Passing-Bablok plots with Deming regression best fit lines. Deming regression was used instead of least-squares because Deming regression is better suited to data where both the X and Y axis data may contain variability. These statistical methods are recommended by the Clinical and Laboratory Standards Institute (CLSI) for handling patient samples [10].

Data and regression statistics for 21 parameters are included in the following graphs. Each value produced by the XN-550 and XS-1000*i* are graphed in a scatter plot. Ideal correlation would correspond to a slope of 1 with an intercept of 0.

Table 6 summarizes the key statistics of the measurements: sample size, ranges, correlations, and confidence intervals.

All of the following blood components showed strong agreement with the measurements obtained from the XS-1000*i* with correlation coefficients ranging from 0.9354 to 0.9999 and exhibiting low bias. Measurements of three blood components (MCHC, BASO%, and MONO#) demonstrated lower correlation (r < 0.90).

Table 6 *Hematology method comparison — statistical summary — XS-1000i vs XN-550*

Type	Sample size (n)	Result range	Correlation coefficient (r)	Standard error of the estimate (SEE)	Slope	95% Confidence interval	Intercept	95% Confidence interval
WBC	195	0.130 to 277.290	1.000	0.504	0.976	0.973 to 0.979	0.031	-0.0465 to 0.1075
RBC	195	1.530 to 6.920	0.996	0.088	1.015	1.002 to 1.028	-0.003	-0.0598 to 0.0536
HGB	195	5.1 to 19.2	0.996	0.260	1.004	0.990 to 1.017	0.120	-0.06 to 0.29
HCT	195	15.7 to 59.8	0.994	0.880	0.998	0.982 to 1.014	-0.050	-0.68 to 0.58
MCV	195	64.0 to 131.0	0.992	1.130	0.954	0.937 to 0.971	2.620	1.04 to 4.21
MCH	195	19.3 to 43.3	0.992	0.450	1.001	0.983 to 1.019	-0.040	-0.60 to 0.52
MCHC	195	29.0 to 37.8	0.894	0.690	1.065	0.996 to 1.135	-1.630	-3.96 to 0.71
RDWSD	193	37.6 to 95.9	0.987	1.600	1.083	1.057 to 1.108	-4.970	-6.28 to -3.65
RDWCV	193	11.8 to 30.1	0.993	0.390	0.980	0.963 to 0.997	-0.230	-0.50 to 0.05
PLT	195	3 to 1295	0.997	11.300	1.010	0.999 to 1.022	1.900	-1.1 to 4.9
MPV	185	8.2 to 14.5	0.955	0.310	0.913	0.873 to 0.953	0.640	0.21 to 1.07
NEUT%	175	2.20 to 94.00	0.998	1.262	0.982	0.972 to 0.992	1.636	1.037 to 2.235
NEUT#	175	0.14 to 34.23	0.998	0.207	0.986	0.978 to 0.995	0.009	-0.039 to 0.058
LYMPH%	175	2.7 to 94.7	0.997	1.580	1.020	1.007 to 1.033	0.330	-0.11 to 0.77
LYMPH#	175	0.18 to 261.98	1.000	0.412	0.999	0.997 to 1.001	0.040	-0.022 to 0.103
MONO%	175	1.7 to 32.5	0.958	1.390	0.898	0.859 to 0.937	-0.350	-0.80 to 0.10
MONO#	175	0.02 to 9.09	0.645	0.310	0.312	0.261 to 0.362	0.346	0.285 to 0.407
EO%	175	0.0 to 13.5	0.987	0.360	1.011	0.987 to 1.036	-0.060	-0.13 to 0.02
EO#	175	0.00 to 1.02	0.993	0.019	1.000	0.981 to 1.018	-0.004	-0.008 to 0.000
BASO%	175	0.0 to 8.2	0.789	0.340	0.443	0.395 to 0.491	0.280	0.22 to 0.34
BASO#	175	0.00 to 1.68	0.935	0.025	0.458	0.432 to 0.483	0.017	0.013 to 0.021

High correlation (r > 0.90)	Lower correlation (r < 0.90)
WBC, RBC, HGB, HCT, MCV, MCH, RDW-SD, RDW-CV, PLT, MPV, NEUT%, NEUT#, LYMPH%, LYMPH#, MONO%, EO%, EO#, BASO#	MCHC, BASO%, and MONO#

2. Linearity of the XN-550

Table 7 lists the manufacturer's reported range and the range reported by the study site for WBC, RBC, HGB, HCT, PLT, and RET.

Graphs of linearity demonstrated that actual values tracked expected values closely for WBC, RBC, HGB, HCT, PLT, and RET. A coefficient of determination for all tests ranged between 0.999 and 1.000 for manufacturer-established linearity.

3. Precision/repeatability of the XN-550 using both pre-dilute and whole blood samples of all parameters from all channels

To determine repeatability, nine whole blood samples were processed through the XN-550 analyzer ten times each.

The same nine blood samples were then diluted (in a 1:7 ratio) and processed again through the analyzer ten times using pre-dilute mode.

The mean, standard deviation, and coefficient of variation were computed and compared for both modes. ***Fig. 1*** charts the mean CV% of the nine samples (i.e., Sample 1 CV% + Sample 2 CV% + ... + Sample 9 CV% divided by 9).

The figure below shows the mean CV% plotted against all the blood components for both pre-diluted and for whole blood.

Fig. 1: Mean CV% of nine samples each of PD(Pre-Dilute) and WB(Whole Blood)

Table 7 *Manufacturer's stated and measured ranges*

	Sysmex		TriCore	
	Low	High	Low	High
WBC, $10^3/\mu L$	0	440	0	556.01
RBC, $10^6/\mu L$	0	8.60	0	8.42
HGB, g/dL	0	26.0	0	27.5
HCT, %	0	75.0	0	74.2
PLT, $10^3/\mu L$	0	5,000	0	5,681.5
RET, %	0	30.0	0	22.35

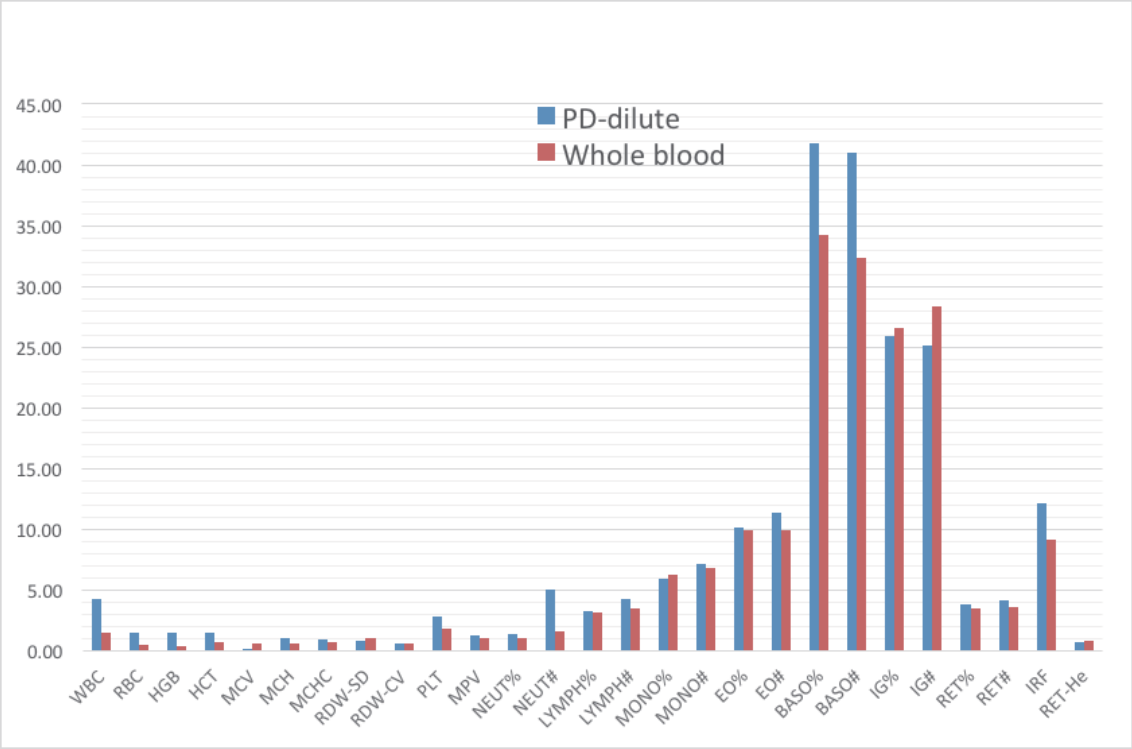


Fig. 1 *Mean CV% of nine samples each of PD (Pre-Dilute) and WB (Whole Blood)*

DISCUSSION

There was high correlation of results (r > 0.90) for most parameters between the new XN-550 and the legacy analyzer XS-1000*i*. Lower correlations were seen for MCHC, BASO%, and MONO#.

Correlation for mean cell hemoglobin content (MCHC) presented with a lower value than the other parameters at r = 0.8935, possibly due to a narrow distribution of sample data in the middle of the range of values skewing the regression curve. Bias was low, however, at 1.7%, and the data points appeared generally in line.

Similarly, the relative basophil count (BASO%) presented with a lower regression, r = 0.7885 and a bias of -13.4%. This may be explained given that basophils are far fewer in number relative to the other types of WBCs and this level of variability has been reported in other studies [4]. The BASO# also demonstrated a similar falloff at higher values, but the coefficient of correlation remained high (r = 0.9354). Bias was greater than most of the other values as well at -21.1%. Most of the data points were below 1.5% and this tends to make the regression line more sensitive to smaller changes than if the data was distributed more evenly. The difference in BASO% may be due to the improved discrimination of cell populations in the XN-550 WDF channel as compared to the DIFF channel on XS-1000*i*.

The blood component with the lowest correlation (r = 0.6449) was for the monocyte absolute count, MONO#. Bias was higher than the other components at -25.7%. The difference in MONO# may be due to the improved discrimination of cell populations in the XN-550 WDF channel as compared to the DIFF channel on XS-1000*i*.

Results showed very high correlation (r2 > 0.999) in linearity throughout the full range of the instruments design with no anomalies observed.

Precision/repeatability was acceptable for both pre-diluted and whole blood samples. Coefficient of variation was low for most blood components; however, basophils (BASO#, BASO%) and immature granulocyte count (IG#, IG%) showed a higher degree of variation, possibly due to improved resolution of scattergrams and limited availability of samples with high values.

Flagging performance, evaluation of the low WBC mode, and performance of the manual analysis sampling method were outside the scope of this study and may be reported on in the future.

The XN-L Series has wide applicability in many diagnostic areas because of its advanced capabilities, small size, ease of use and commonality to the larger XN Series analyzers. The XN-L is especially well suited for use in urgent care and free standing emergency rooms, family practice and pediatric clinics, dialysis centers and oncology units. This series of hematology analyzers delivers solutions for laboratories and clinics that offer niche diagnostic testing. Dedicated functionalities support the following medical specialties.

In urgent care settings the small footprint and high throughput are beneficial when space and time are limited. Also the XN-L Series offers the automated Immature Granulocyte (IG) which may be an indication of infection or inflammation. Body fluid analysis (BF mode) is available for use with cerebrospinal, serous and synovial fluids which may reduce the need for more time consuming manual laboratory methods. The BF mode offers a total cell count, WBC, RBC, and a two-part differential for standardized body fluid analysis.

Physician office laboratories handling family practice, internal medicine and pediatric patients have opportunity with the XN-L Series analyzers. Accurate results make this system a must for routine health screening and the routine care of patients with chronic conditions. Pediatric populations can benefit from the low sample aspiration volume of 25 µL and the enhanced nRBC flagging capabilities. By decreasing the amount of blood drawn from these children the risk of phlebotomy-induced anemia is reduced. As some estimates suggest that iron deficiency affects roughly ten percent of the pediatric population, the RET-H_e parameter (Reticulocyte Hemoglobin Equivalent) has been shown to be a sensitive marker to detect iron deficiency before it progresses to anemia.

In dialysis centers these analyzers can offer a comprehensive reticulocyte panel including IRF and RET-H_e. Anemia is often a chronic concern in kidney patients since erythropoietin stimulates red cell production in the bone marrow and it is naturally produced in the kidney. The RET-H_e parameter is a sensitive way to detect iron deficiency earlier in chronic kidney disease patients. It may be more useful than traditional iron studies as it is not affected by inflammation or the acute phase response.

For oncology patients who present with leukocytopenia secondary to chemotherapy and treatment, the XN-L analyzer offers accurate white cell measurements using Low WBC mode. By increasing the analysis duration three times longer, more cell events are counted ensuring a more precise measurement on these usually challenging specimens. For fast-paced oncology centers the continuous sample loading and auto rerun/reflex of the XN-550 accommodates a high volume throughput with minimal technologist intervention, therefore allowing timely result reporting of absolute neutrophil counts.

CONCLUSION

The XN-L Series of hematology analyzers demonstrates a high degree of correlation with the legacy XS-1000*i* instrument, has acceptable linearity throughout its full range of detection, and provides a high degree of repeatability for both whole blood and pre-diluted blood. XN-L can provide standardized testing from Core Lab to satellite labs, and affiliated Clinics and Physician Office Laboratories. Improved functionality of the XN-L Series

analyzer over the XS-Series includes: a sampler with continuous sample loading, enhanced nRBC flagging, the addition of on-board rules and more sample data storage, a 6-part differential including IG, a L-WBC mode for more accurate counts in leukopenic samples, and optional reticulocyte and body fluid capabilities.

In addition to the sophisticated diagnostics, Sysmex offers comprehensive support, advanced software and process optimization to make small and medium-sized labs more productive. For example, Sysmex offers sophisticated continuing education including webinars, virtual classrooms, in-person instruction, regional symposia, and user groups to maximize staff efficiency. To proactively decrease unanticipated downtime, it is possible to connect the XN-L Series to the secure Sysmex Network Communications System (SNCS) which allows continuous analyzer monitoring, automated peer-comparison and easy calibration verification.

References

1) *Geara C, Cornet E, Troussard X. Comparative study of quantitative performances between the new Sysmex XN-L (XN-550) haematology analyser and the XN-9000 in a routine laboratory. Int J Lab Hematol. 2016;38:10?1. doi: 10.1111/ijlh.12441. Epub 2015 Oct 28.*
2) *Fleming C, Brouwer R, Lindemans J, de Jonge R. Validation of the body fluid module on the new Sysmex XN-1000 for counting blood cells in cerebrospinal fluid and other body fluids. Clin Chem Lab Med. 2012;50(10):1791-8. doi: 10.1515/cclm-2011-0927*
3) *Briggs C, Longair I, Kumar P, Singh D, Machin SJ. Performance evaluation of the Sysmex haematology XN modular system. J Clin Pathol. 2012 Nov; 65(11): 1024-30. doi: 10.1136/jclinpath-2012-200930. Epub 2012 Jul 31.*
4) *Seo JY, Lee ST, Kim SH. Performance evaluation of the new hematology analyzer Sysmex XN-Series. Int J Lab Hematol. 2015;37(2): 155-64 doi: 10.1111/ijlh.12254. Epub 2014 May 12.*
5) *Jo SY, Park SH, Kim IS, Yi J, Kim HH, Chang CL. Performance evaluation of recently launched Sysmex XN-550 Automatic Hematology Analyzer. Int J Lab Hematol. 2017 Feb;39(1):e4-e9. doi: 10.1111/ijlh.12571. Epub 2016 Aug 27.*
6) *Hotton J, Broothaers J, Swaelens C, Cantinieaux B. Performance and Abnormal Cell Flagging Comparisons of Three Automated Blood Cell Counters. Am J Clin Pathol. 2013;140:845? 52 doi: 10.1309/AJCPE5R4SOQBUULZ*
7) *Sysmex XN-L Instructions for Use*
8) *Hamaguchi Y, Kondo T, Nakai R, Ochi Y, Okazaki T, Uchihashi K, Morikawa T. Introduction of Products: Overview and Features of the Automated Hematology Analyzer XN-L Series. Sysmex Journal International. 2015;25(1)*
9) *Passing H, Bablok W. A new biometrical procedure for testing the equality of measurements from two different analytical methods. Application of linear regression procedures for method comparison studies in Clinical Chemistry, Part I.ÅıJ Clin Chem Clin Biochem. 1983 Nov;21(11):709-20.*
10) *Briggs C, Culp N, Davis B, d'Onofrio G, Zini G, Machin SJ, International Council for Standardization in Haematology, Writing Group. ICSH guidelines for the evaluation of blood cell analysers including those used for differential leucocyte and reticulocyte counting. Int J Lab Hematol. 2014 Dec;36(6):613-27. doi: 10.1111/ijlh.12201. Epub 2014 Mar 25.*