How to Bring the Work(flow) in the Flow Lab

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Overview

- **Flow in a Multi-Site Laboratory**
- **Technical Workflow**
- **IT Workflow**
- **Perspectives**

Overview

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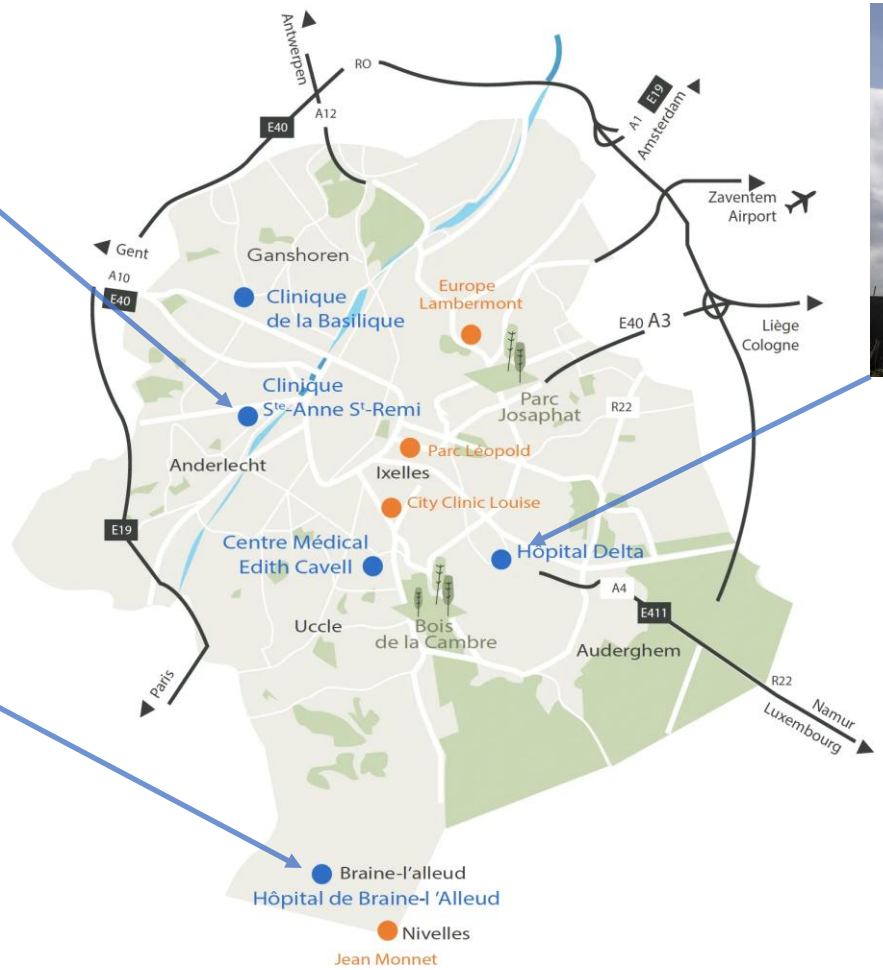
Chirec Hospital Laboratory

SARE

HBW



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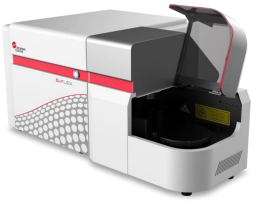

800 CBCs+ / day
300+ bone marrows / year

Overview

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- **Technical Workflow**
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- Perspectives

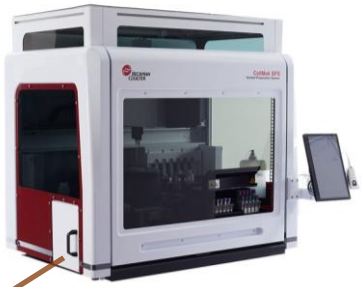
Hematology Workflow

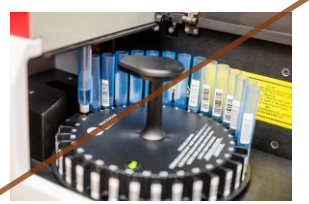
Outpatient Clinics sampling

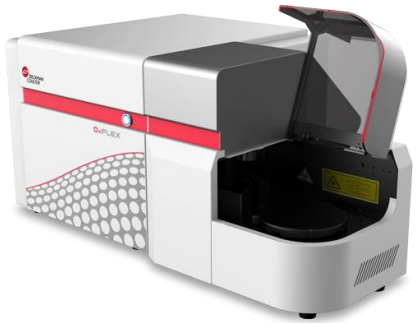
On-site sampling & handling

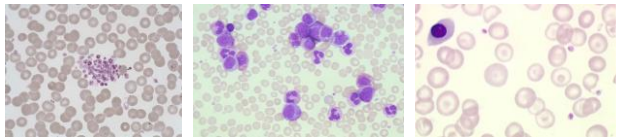
On-site storage
5 days
4°C

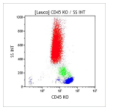
Flow Cytometry Workflow











CD45-KrO, J33, 100 Tests, CE

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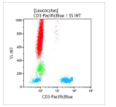


CD3-PB, UCHT1, 50 Tests, CE

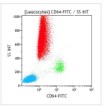
Product No: **B49204** FLOW Reagent

CD19-PC7, J3-119, 100 Tests, CE

Product No: **IM3628** FLOW Reagent

CD16-PC5, 3G8, 100 Tests, CE

Product No: **A07767** FLOW Reagent



CD64-FITC, 22, 100 Tests, CE

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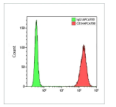
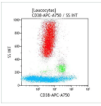


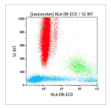
CD34-APC-A700, 581, 50 Tests, CE

Product No: **B92417** FLOW Reagent



CD38-APC-A750, LS198-4-3, 50 Tests, CE

Product No: **B49200** FLOW Reagent



HLA-DR-ECD, Immu-357, 100 Tests, CE

Product No: **B92438** FLOW Reagent

10-20 slides a day / site (excluding body fluids and Kleihauer)

CDE panel (30-70 a day / 14.000 a year)

Other automated in-house panels: TBNK (1000 a year), KL (1500 a year) , SLD (1400 a year), HLA-B27 (740 a year)

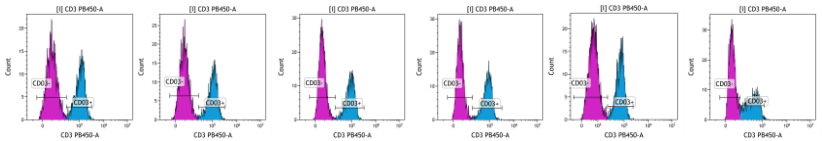
Flow 7 days a week

CDE preparation and sensitivity

Random access loading of samples

whole blood EDTA
+
CDE Mix of Antibodies

Incubation

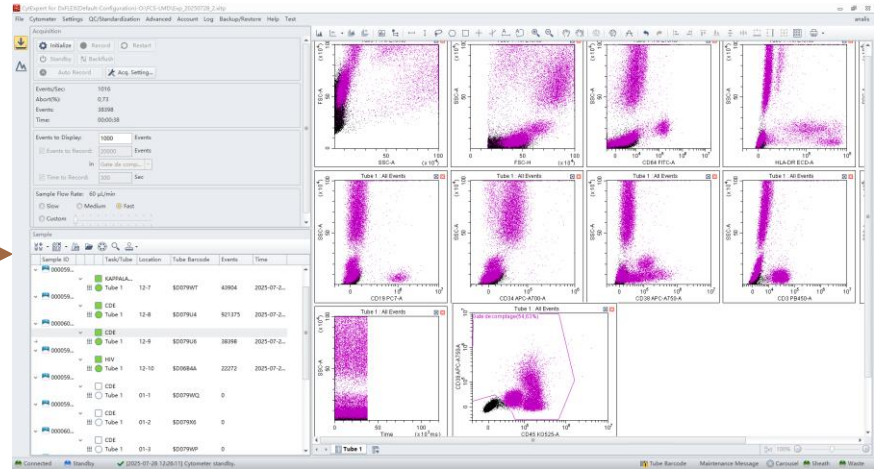


VersaLyse

Incubation

CytExpert Software

Automated acquisition
Stopping gate: 20.000 leucocytes
Maximum time : 5 minutes per tube



CDE precision

Table II

95%-PREDICTION INTERVALS (IN %) for the results of a very large number of differential counts in smears from one sample of blood.

t	n = 100	n = 200	n = 500	n = 1000
1	0- 3	0 - 2.5	0.2- 2.0	0.4- 1.7
2	0- 5	0.5- 4	0.8- 3.4	1.2- 2.9
3	0- 7	1 - 5.5	1.6- 4.6	2.0- 4.1
4	1- 8	1.5- 7	2.4- 5.8	2.8- 5.3
5	1-10	2 - 8	3.2- 7.0	3.7- 6.4
6	2-11	3 - 9.5	4.0- 8.2	4.6- 7.5
7	2-12	3.5-10.5	4.8- 9.4	5.5- 8.6
8	3-14	4.5-12	5.8-10.4	6.4- 9.7
9	4-15	5 -13	6.6-11.6	7.3-10.8
10	5-16	6 -14.5	7.4-12.8	8.2-11.9
15	8-22	10 -20	12.0-18.2	12.8-17.2
20	12-28	14.5-25.5	16.6-23.6	17.6-22.5
25	17-34	19 -31	21.2-28.8	22.3-27.7
30	21-39	24 -36.5	26.0-34.0	27.2-32.9
35	26-44	28.5-41.5	30.8-39.2	32.1-38.0
40	31-50	33.5-47	35.8-44.4	37.0-43.0
45	35-55	38 -52	40.6-49.4	41.9-48.1
50	40-60	43 -57	45.6-54.4	46.0-53.1

n is the total number of cells counted; t is the real percentage of cells of a given type. The cited limits are included in the 95%-prediction interval.

Ruemke CL. The statistically expected variability in differential counting. In: Koepke JA: Differential leukocyte counting. College of American Pathologists, Sokie, Illinois. 1979

Table 1 *95% confidence limits for the actual number of cells per 100 WBC. A = observed cells per 100 WBC.*

	Actual number of cells per 100 WBC				
A	n = 100	n = 200	n = 500	n = 1,000	n = 10,000
0	0–3.6	0–1.8	0–0.7	0–0.4	0–0.1
1	0.0–5.4	0.1–3.6	0.3–2.3	0.5–1.8	0.8–1.3
5	1.6–11.3	2.4–9.0	3.3–7.3	3.7–6.5	4.5–5.5
10	4.9–17.6	6.2–15.0	7.5–13.0	8.2–12.0	9.4–10.7
15	8.6–23.5	10.4–20.7	12.0–18.4	12.8–17.4	14.3–15.8
20	12.7–29.2	14.7–26.2	16.6–23.8	17.6–22.6	19.2–20.8
30	21.2–40.0	23.7–36.9	26.0–34.2	27.2–32.9	29.1–31.0
40	30.3–50.3	33.2–47.1	35.7–44.4	36.9–43.1	39.0–41.0
50	39.8–60.2	42.9–57.1	45.5–54.5	46.9–53.1	49.0–51.0
70	60.0–78.8	63.1–76.3	65.8–74.0	67.1–72.8	69.0–70.9
80	70.8–87.3	73.8–85.3	76.2–83.4	77.4–82.4	79.2–80.8
90	82.4–95.1	85.0–93.8	87.0–92.5	88.0–91.8	89.3–90.6
100	96.4–100	98.2–100	99.3–100	99.6–100	99.9–100

Sysmex educational enhancement and development, SEED Haematology, April 2016

CDE precision and specificity

Table 1 Coefficients of variation (CV), and mean percentages of cells ($\bar{x}$), corresponding to B-E imprecision in differential leukocyte counting

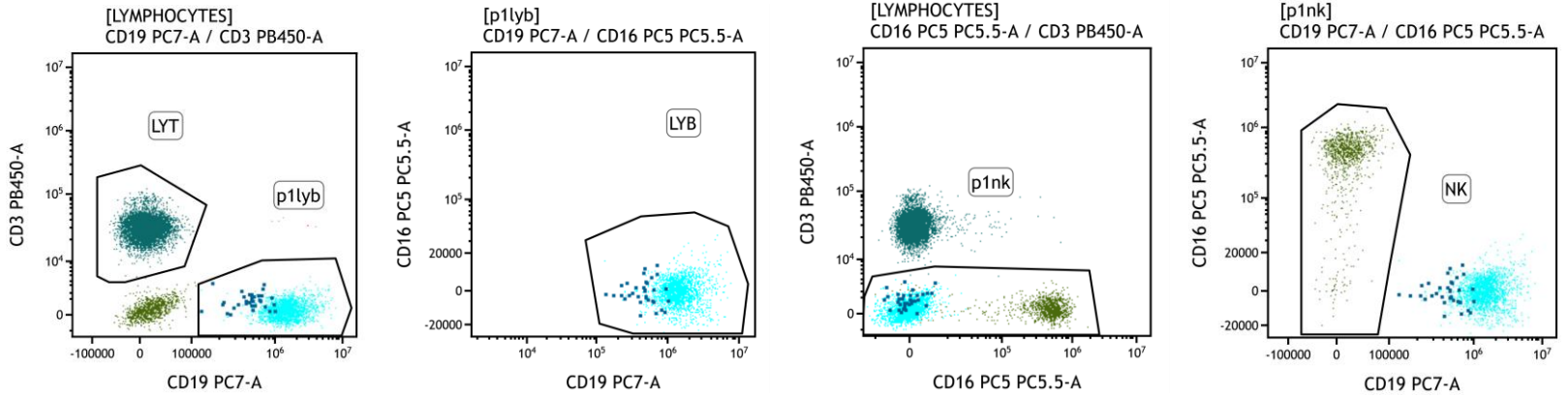
Quantity	$\bar{x}$(%)	CV (%)
Lkcs (B)—neutrophilocytes; num. fr.	78.15	6.6
Lkcs (B)—lymphocytes; num. fr.	10.78	32.5
Lkcs (B)—monocytes; num. fr.	4.91	55.0
Lkcs (B)—eosinophilocytes; num. fr.	1.88	68.8
Lkcs (B)—basophilocytes; num. fr.	0.19	263.2
Lkcs (B)—myelocytes; num. fr.	0.83	132.5
Lkcs (B)—metamyelocytes; num. fr.	3.16	69.6

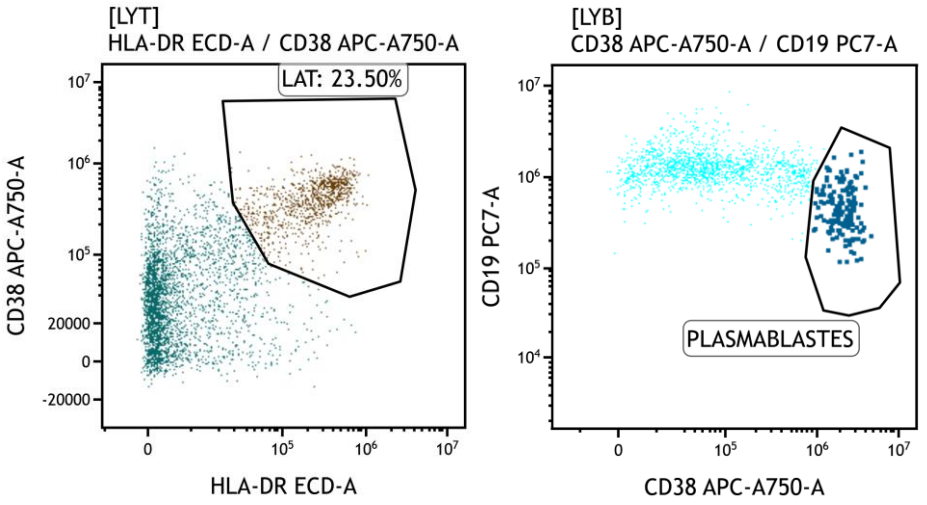
Quantities corresponding to the differential leukocyte counting are described in accordance with the standards EN 1614 [6] and ISO 15189 [7]

Lkcs, leukocytes; B, blood; num. fr., number fraction

Fuentes-Arderiu, X., García-Panyella, M. & Dot-Bach, D. Between-examiner reproducibility in manual differential leukocyte counting. Accred Qual Assur 2007

Zini, G.
Hematological cytomorphology: Where we are
IJLH2024





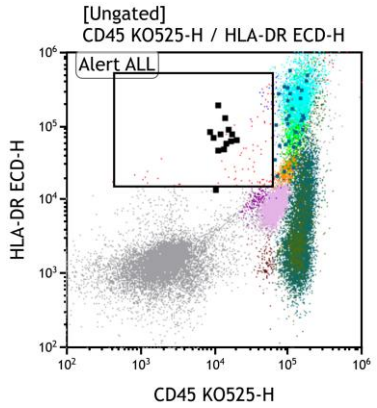
GB	GLOBULES BLANCS	5		1	11.7	1000/mm³
NEU	NEUTROPHILES	5	↓	1	22.5	%
NEUVA	NEUTROPHILES (VA)	5		1	2.63	1000/mm³
EOS	EOSINOPHILES	5	↓	1	0.7	%
EOSA	EOSINOPHILES (VA)	5		1	0.08	1000/mm³
BAS	BASOPHILES	5		1	0.1	%
BASOVA	BASOPHILES (VA)	5		1	0.02	1000/mm³
MON	MONOCYTES	5		1	1.1	%
MONOVA	MONOCYTES (VA)	5		1	0.13	1000/mm³
LYM	LYMPHOCYTES	5	↓	1	30.4	%
LYMVA	LYMPHOCYTES (VA)	5	↓	1	3.55	1000/mm³
LYTCD	LYMPHOCYTES T	5		1	2.370	1000/mm³
LYBCD	LYMPHOCYTES B	5		1	0.990	1000/mm³
NKCD	LYMPHOCYTES NK	5		1	0.180	1000/mm³
LYAT	LYMPHOCYTES ATYPIQUE	5		1	0.2	%
PLBLCD	PLASMABLASTES	5		1	0.0	/µL
BLA	BLASTES	5	↑	1	42.64	%
BLAVA	BLASTES VA	5	↑	1	4.990	1000/mm³
GRIM	GRANULOCYTES IMMATUR	5		1	2.3	%

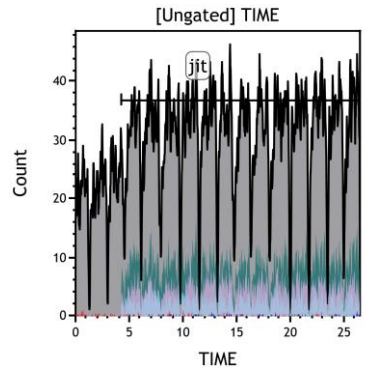
CDE gating

10 Technicians (7.6 FTE)

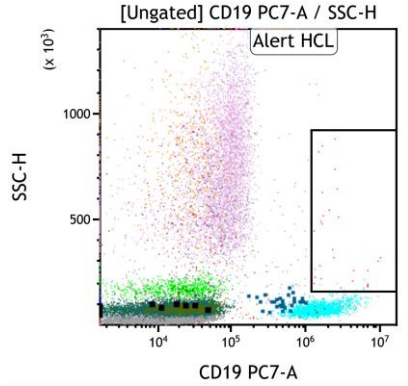
KALUZA Software

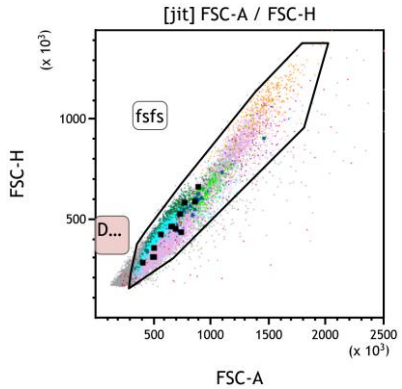
> 50% of CDE analyses < 1 minute





GAP 0.11

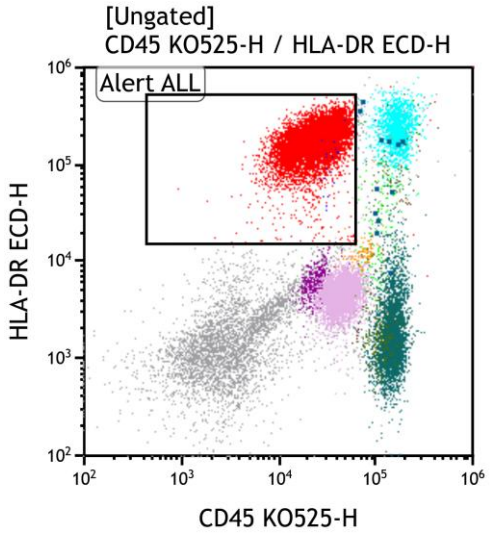


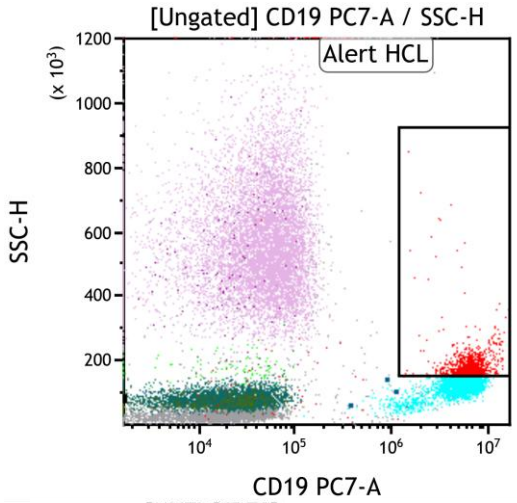


- ***Lymphosum***=*(COUNT("LYT", 1)+COUNT("LYB", 1)+COUNT(NK, 1))/COUNT("LYMPHOCYTES", 1)*100*
- ***Leucosum***=*(COUNT("MYELOIDES", 1)+COUNT("LYMPHOCYTES", 1)+COUNT(MONOCYTES, 1)+COUNT (EOSINOPHILES, 1)+COUNT("BASOPHILES", 1)+COUNT("BLASTES", 1))/COUNT(CELLULES, 1)*100*
- ***Gap***=*(COUNT(CELLULES, 1)-COUNT("MYELOIDES", 1)-COUNT("LYMPHOCYTES", 1)-COUNT(MONOCYTES, 1)- COUNT(EOSINOPHILES, 1)-COUNT("BASOPHILES", 1)-COUNT("BLASTES", 1))/COUNT(CELLULES, 1)*100*

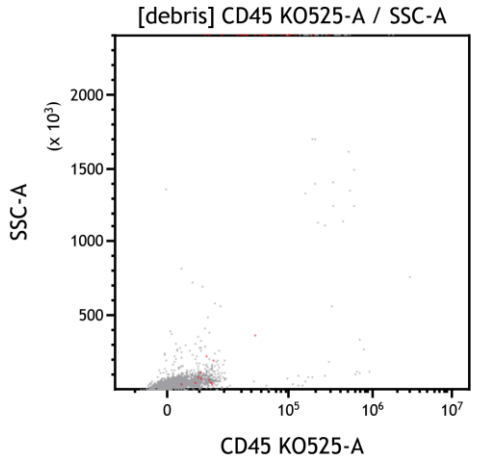
CDE gating

'Alert Gates'

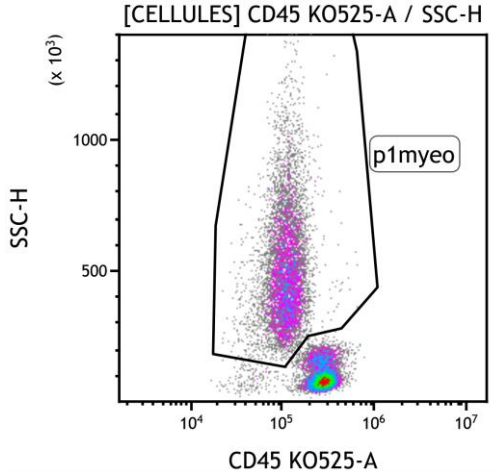


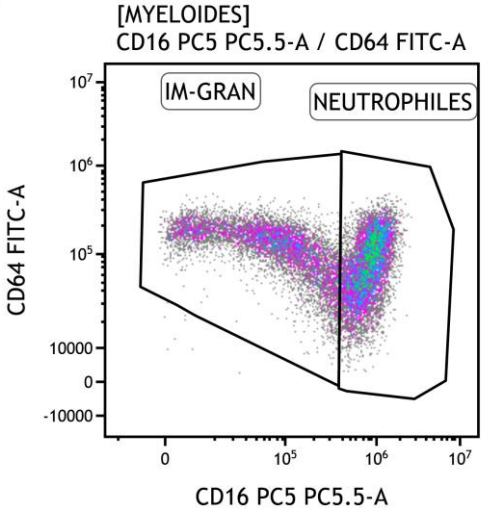


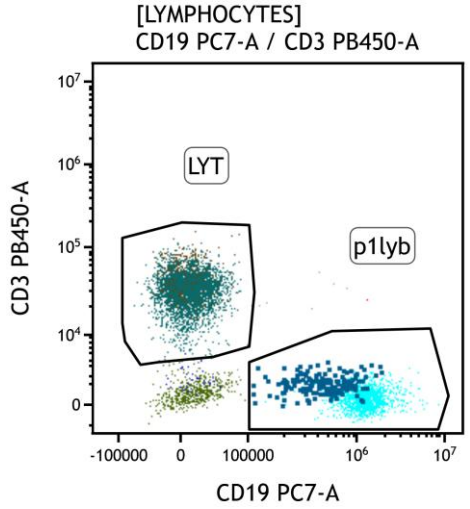
Final 'Debris Gate' Boolean Gate = 'NOT CELLS'

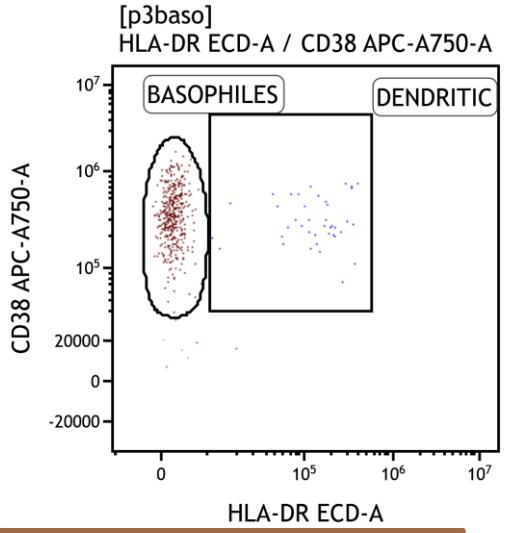


Cell Population Allocation Gates that might require adjustments





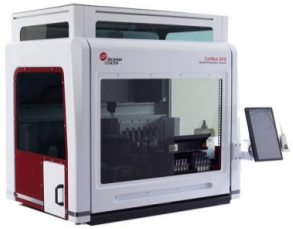


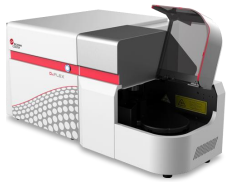


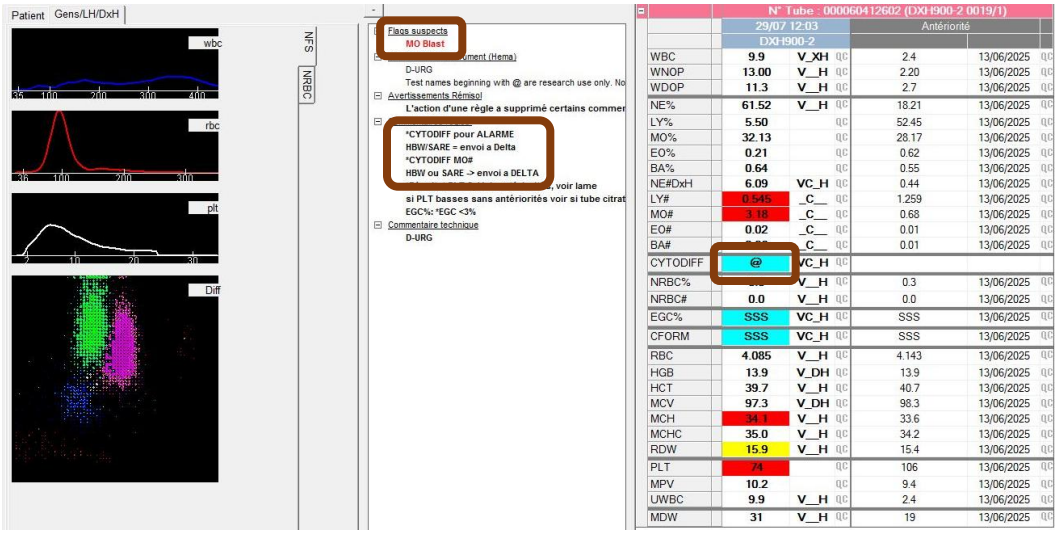
Gap < 0.8 → Send CDE results

Gap ≥ 0.8 → more thorough analysis

Other automated panels
- Reflex testing -







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WNOP	13.00	V__H	QC	2.20	13/06/2025
WDOP	11.3	V__H	QC	2.7	13/06/2025
NE%	61.52	V__H	QC	18.21	13/06/2025
LY%	5.50		QC	52.45	13/06/2025
MO%	32.13		QC	28.17	13/06/2025
EO%	0.21		QC	0.62	13/06/2025
BA%	0.64		QC	0.55	13/06/2025
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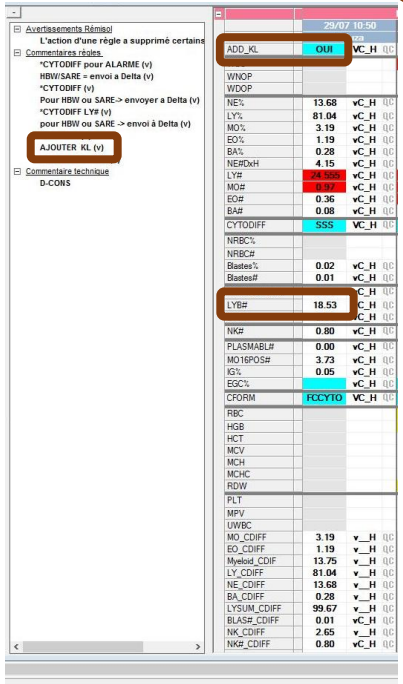
MO#	3.18	_C__	QC	0.68	13/06/2025
EO#	0.02	_C__	QC	0.01	13/06/2025
BA#		_C__	QC	0.01	13/06/2025
CYTODIFF	@	VC_H	QC		
NRBC%		V__H	QC	0.3	13/06/2025
NRBC#	0.0	V__H	QC	0.0	13/06/2025
EGC%	SSS	VC_H	QC	SSS	13/06/2025
CFORM	SSS	VC_H	QC	SSS	13/06/2025
RBC	4.085	V__H	QC	4.143	13/06/2025
HGB	13.9	V_DH	QC	13.9	13/06/2025
HCT	39.7	V__H	QC	40.7	13/06/2025
MCV	97.3	V_DH	QC	98.3	13/06/2025
MCH	34.1	V__H	QC	33.6	13/06/2025
MCHC	35.0	V__H	QC	34.2	13/06/2025
RDW	15.9	V__H	QC	15.4	13/06/2025
PLT	74		QC	106	13/06/2025
MPV	10.2		QC	9.4	13/06/2025
UWBC	9.9	V__H	QC	2.4	13/06/2025
MDW	31	V__H	QC	19	13/06/2025



29/07 10:50

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WDOP			
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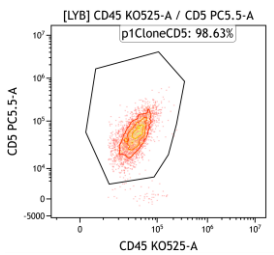
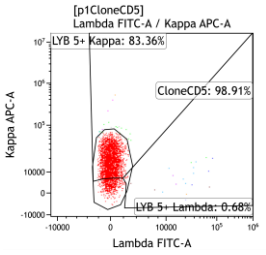
LY%	81.04	vC_H	QC
MO%	3.19	vC_H	QC
EO%	1.19	vC_H	QC
BA%	0.28	vC_H	QC
NE#DxH	4.15	vC_H	QC
LY#	24.555	vC_H	QC
MO#	0.92	vC_H	QC
EO#	0.36	vC_H	QC
BA#	0.08	vC_H	QC
CYTODIFF	SSS	VC_H	QC
NRBC%			
NRBC#			
Blastes%	0.02	vC_H	QC
Blastes#	0.01	vC_H	QC
		C_H	QC
LYB#	18.53	C_H	QC
		C_H	QC
NK#	0.80	vC_H	QC
PLASMABL#	0.00	vC_H	QC
MO16POS#	3.73	vC_H	QC
IG%	0.05	vC_H	QC
EGC%		vC_H	QC
CFORM	FCCYTO	VC_H	QC
RBC			
HGB			
HCT			
MCV			
MCH			
MCHC			
RDW			
PLT			
MPV			
UWBC			
MO_CDIFF	3.19	v__H	QC
EO_CDIFF	1.19	v__H	QC
Myeloid_CDIF	13.75	v__H	QC
LY_CDIFF	81.04	v__H	QC
NE_CDIFF	13.68	v__H	QC
BA_CDIFF	0.28	v__H	QC
LYSUM_CDIFF	99.67	v__H	QC
BLAS#_CDIFF	0.01	vC_H	QC
NK_CDIFF	2.65	v__H	QC
NK#_CDIFF	0.80	vC_H	QC



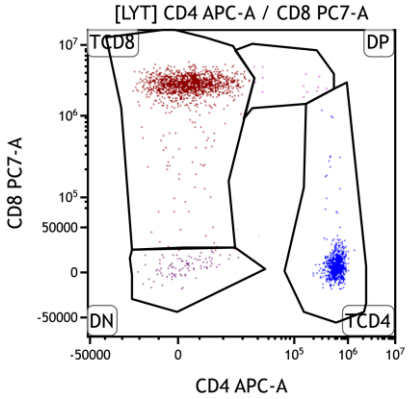


	Kaluza	
PLASMO%_KL	0.00	v__H
KL_HEMATOG%	0.02	v__H
KL_TRANSIT%	0.00	v__H
KL_BNAIFSA%	0.00	v__H
KL_BMEMOIR%	12.02	v__H
LY%_KL	81.72	v__H
LYB%_KL	76.29	v__H
KL_CD27PIGDP	0.02	v__H
KL_CD27POS%	89.95	v__H
KL_KAPPA%	87.57	v__H
KL_LAMBDA%	0.22	v__H
KL_CD10%	0.04	v__H
KL_CD27%	89.95	v__H
KL_CD5%	99.21	v__H
KL_CD200%	98.15	v__H
KL_IGD%	2.14	v__H
KL_CD38%	93.35	v__H
KL_CD45%	100.00	v__H

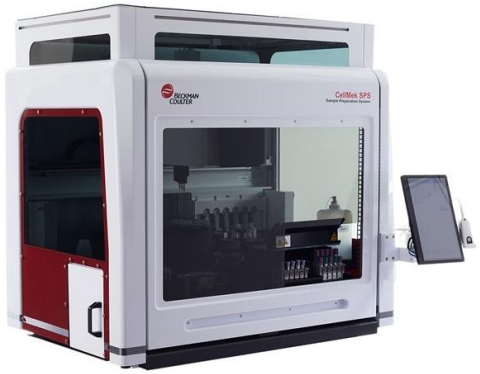
Other automated panels
- As prescribed -

TBNK

(Lyse No Wash)

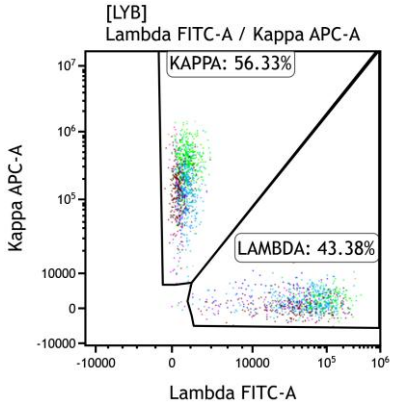


TBNK (1000 a year)



K/L

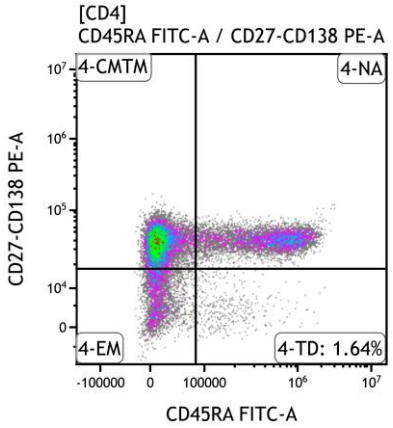
(Lyse Wash)



KL (1500 a year)

SLD

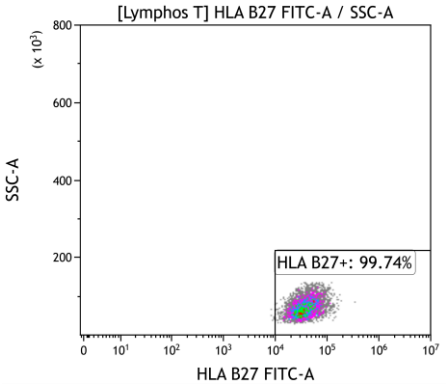
(Lyse No Wash)



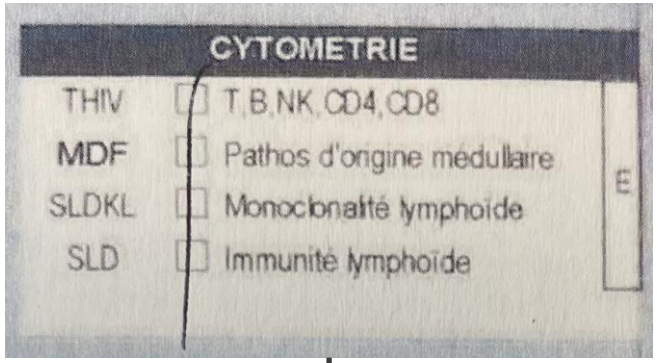
SLD (1400 a year)

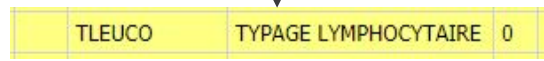
HLA-B27

(Lyse No Wash)



HLA-B27 (740 a year)





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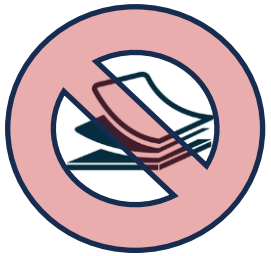
Overview

- Flow in a Multi-Site Laboratory
- Technical Workflow
- **IT Workflow**
- Perspectives

IT connections for Flow



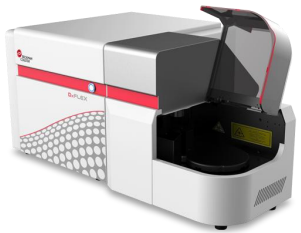
CHirec Hospital Group

xperthis CARE

CGM CompuGroup Medical

MOLIS Laboratory Information System

navify Roche



Valab

Overview

- Flow in a Multi-Site Laboratory
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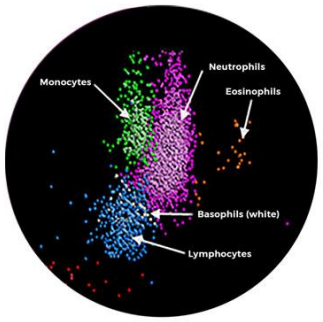
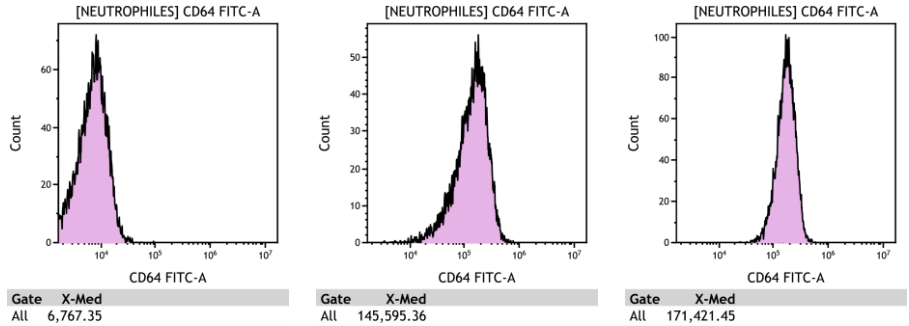
Perspectives

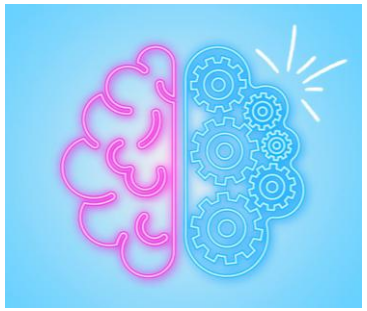
Activated Monocytes



Septic

MDW=28.6





Acknowledgments

BECKMAN COULTER Life Sciences

CHirec Hospital Group

Olivier Pradier MD PhD