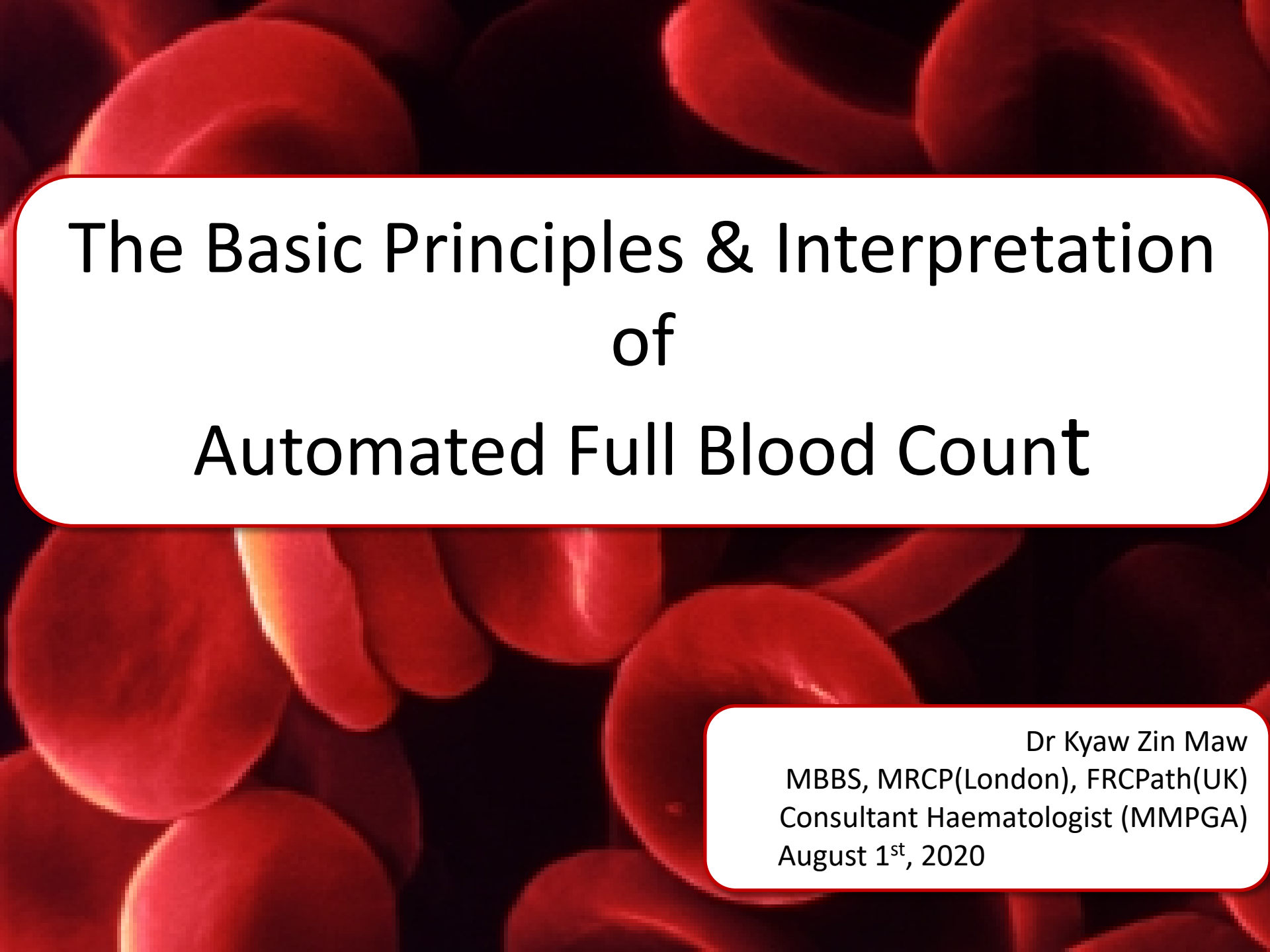
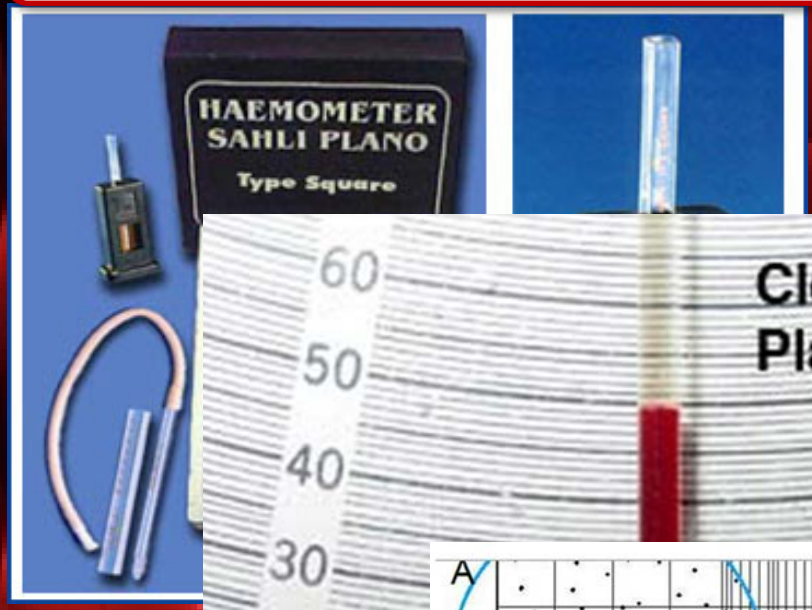
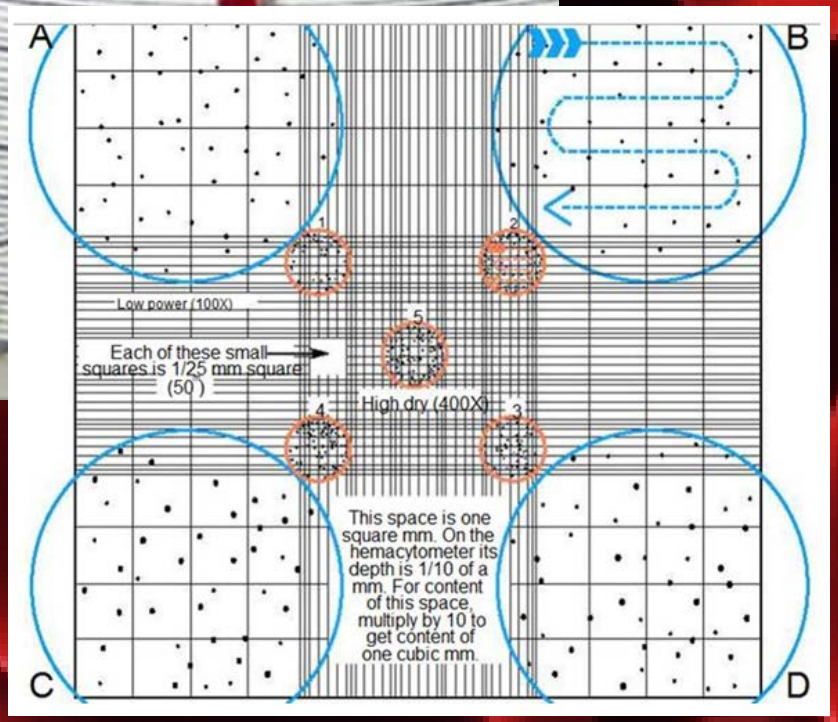


The Basic Principles & Interpretation of Automated Full Blood Count

Dr Kyaw Zin Maw
MBBS, MRCP(London), FRCPath(UK)
Consultant Haematologist (MMPGA)
August 1st, 2020

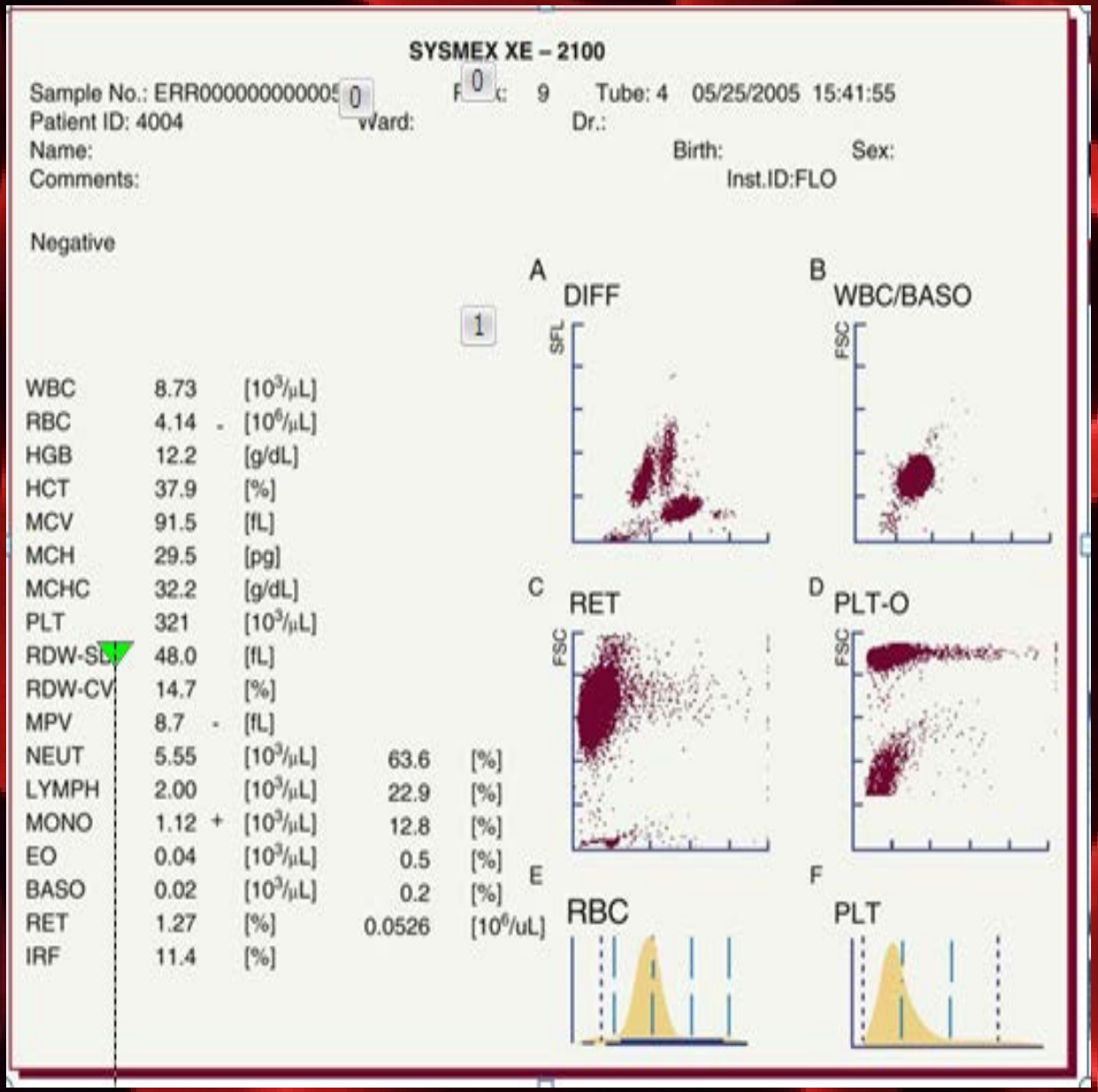
Old Methods of FBC





- INTRODUCTION
- CASE SCENARIO 1
- CASE SCENARIO 2
- CASE SCENARIO 3
- CASE SCENARIO 4 -10
- CONCLUSION

Automated Complete Blood Count



INTRODUCTION

CASE SCENARIO 1

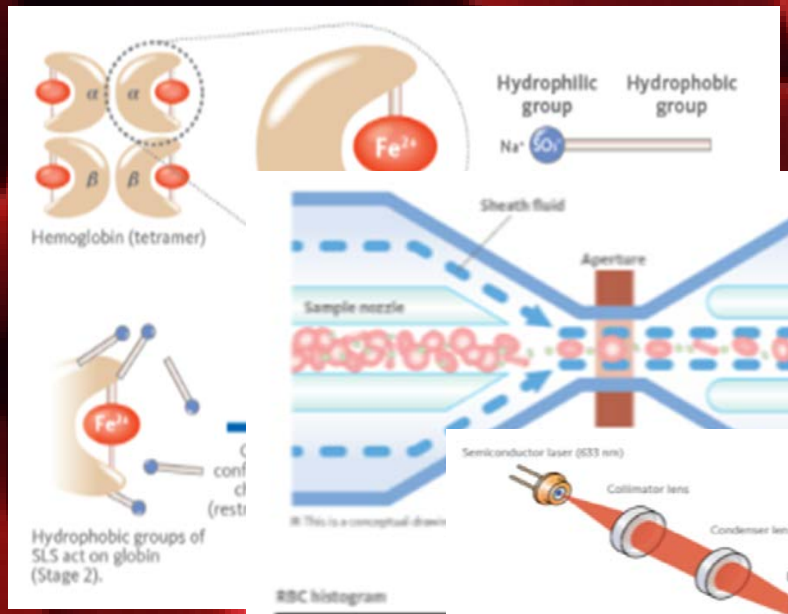
CASE SCENARIO 2

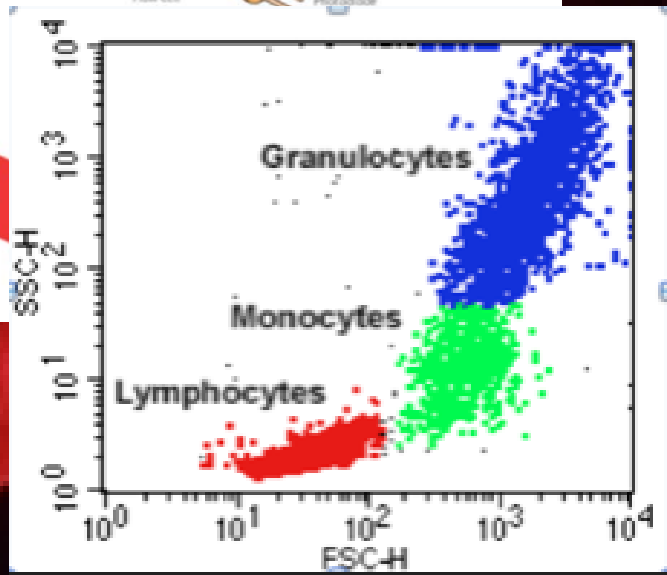
CASE SCENARIO 3

CASE SCENARIO 4 -10

CONCLUSION

Automated Complete Blood Count





INTRODUCTION

CASE SCENARIO 1

CASE SCENARIO 2

CASE SCENARIO 3

CASE SCENARIO 4-10

CONCLUSION

SML Laboratory

XN-L SML

Sample No.: 4
Patient ID: 170210745
Name: [redacted]
Diff. Morph. Count

Ward:
Doctor: SELF
Age: 31 Sex: Male

28/02/2017
09:17:37
XN-450^11173

			Reference Interval	
WBC	19.78 + [10^3/uL]		(4.00 - 10.50)	
NEUT	50.9 * [%]	10.07* [10^3/uL]	(40.0 - 75.0)	(1.50 - 6.60)
LYMPH	38.5 * [%]	7.62* [10^3/uL]	(20.0 - 50.0)	(1.50 - 3.50)
MONO	5.0 * [%]	0.98* [10^3/uL]	(2.0 - 10.0)	(0.00 - 1.00)
EO	0.6 * [%]	0.12* [10^3/uL]	(1.0 - 6.0)	(0.00 - 0.70)
BASO	5.0 * [%]	0.99* [10^3/uL]	(0.0 - 1.0)	(0.00 - 0.10)
IG	0.3 * [%]	0.05* [10^3/uL]	(0.00 - 7.00)	(0.0 - 72.0)
RBC	4.00 * [10^6/uL]		(4.70 - 6.00)	
HGB	7.9 - [g/dL]		(13.5 - 18.0)	
HCT	24.4 * [%]		(42.0 - 52.0)	
MCV	61.0 * [fL]		(78.0 - 100.0)	
MCH	19.8 * [pg]		(27.0 - 31.0)	
MCHC	32.4 * [g/dL]		(32.0 - 36.0)	
RDW-SD	62.1 * [fL]		(36.4 - 46.3)	
RDW-CV	29.0 * [%]		(11.5 - 14.0)	
PLT	238 * [10^3/uL]		(150 - 450)	
PDW	---- [fL]		(8.0 - 18.0)	
MPV	---- [fL]		(6.0 - 9.5)	
P-LCR	---- [%]		(13.0 - 43.0)	
PCT	---- [%]		(0.20 - 0.50)	
RET	[%]	[10^6/uL]	(0.40 - 1.00)	(0.0000 - 0.9999)
IRF	[%]		(0.0 - 100.0)	
LFR	[%]		(0.0 - 100.0)	
MFR	[%]		(0.0 - 100.0)	
HFR	[%]		(0.0 - 100.0)	
RET-He	[pg]		(0.0 - 99.9)	
IPF	[%]	[10^3/uL]	(0.0 - 99.9)	(0.0 - 999.9)

WB
WDF
RET
PLT-O
RBC
PLT

WBC IP Message
WBC Abn Scattergram
Lymphocytosis
Basophilia
Leukocytosis
Blasts/Abn Lympho?
NRBC?

RBC IP Message
RBC Abn Distribution
Anisocytosis
Microcytosis
Anemia
Fragments?

PLT IP Message
PLT Abn Distribution

Blood Film Report

RBC: anisopoikilocytosis with hypochromia, microcytes
elliptical cells+, target cells+, fragmented cells+, nucleated RBC+20/100 WBCs

WBC: leucocytosis with normal differential count

PLT : normal,clumps+

PROFESSOR AYE AYE MYINT
M.B.,B.S, D.P (YGN)
Ph.D(London), Ph.D (HON)(YGN)
Consultant Pathologist

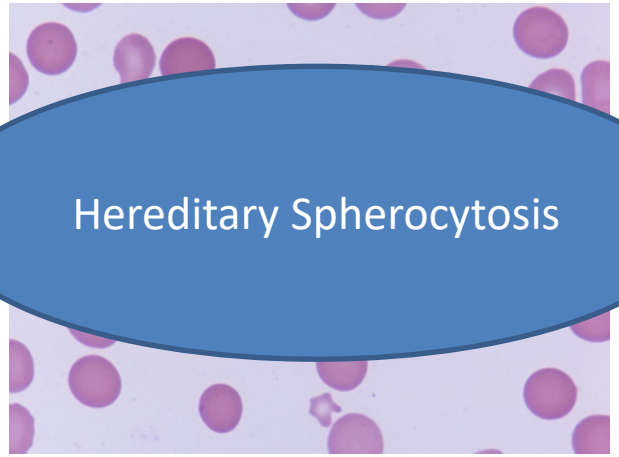
1/1

Hb	100 [g/L]	[130-180]
MCV	82 [fL]	[78-100]
Hct	32.4[%]	[42-52]
RBC	3.7[10^6/uL]	[4.5-5.8]
MCH	26 [pg]	[27-33]
MCHC	36.8[g/dL]	[33-36]
RDW-SD	42 [fL]	[36.4-46.3]
RDW-CV	13.6[%]	[11.6-14.0]
NRBC	-	
RET	108 [x10^6/L]	[40-100]
RET-He	33 [pg]	[28-36]
IRF	13.4[%]	[1.6-12.1]

MCH = Average Hb concentration of the average cell (Hb / RBC)

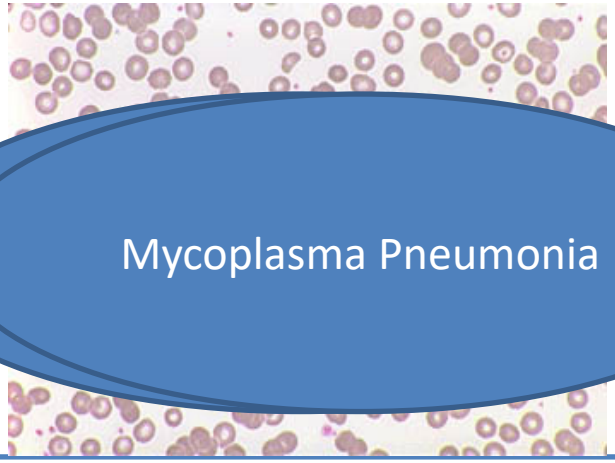
MCHC = Average Hb concentration of a given red cell volume (Hb / Hct)

MCH (Mean Corpuscular Haemoglobin)
MCHC (Mean Corpuscular Haemoglobin Concentration)



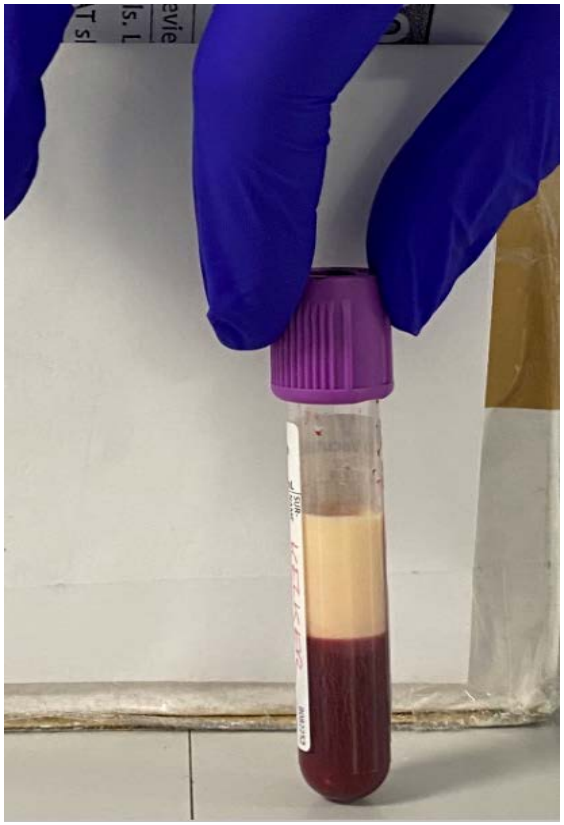
Hereditary Spherocytosis

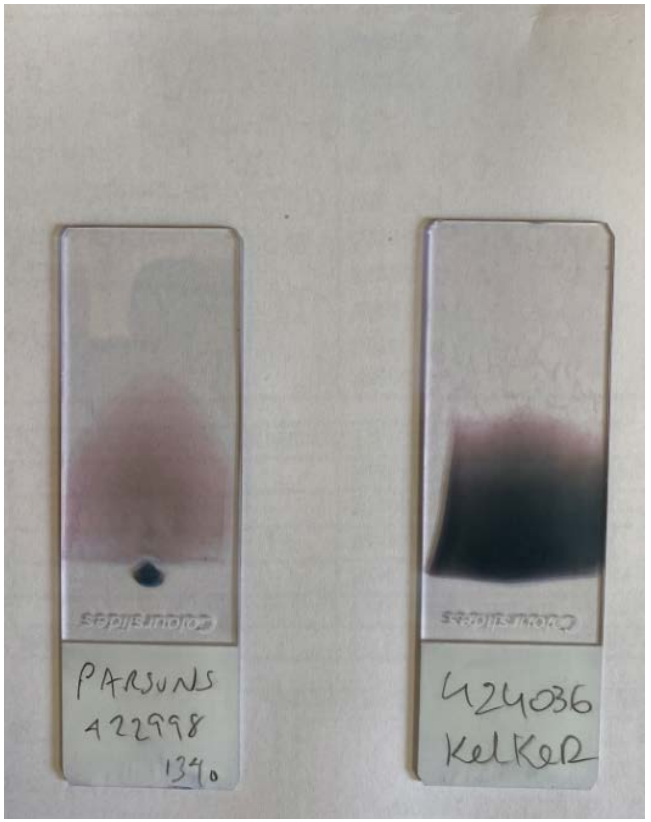
Hb	100	[g/L]	[130-180]
MCV	82	[fL]	[78-100]
Hct	32.4	[%]	[42-52]
RBC	3.7	[10^6/uL]	[4.5-5.8]
MCH	26	[pg]	[27-33]
MCHC	36.8	[g/dL]	[33-36]

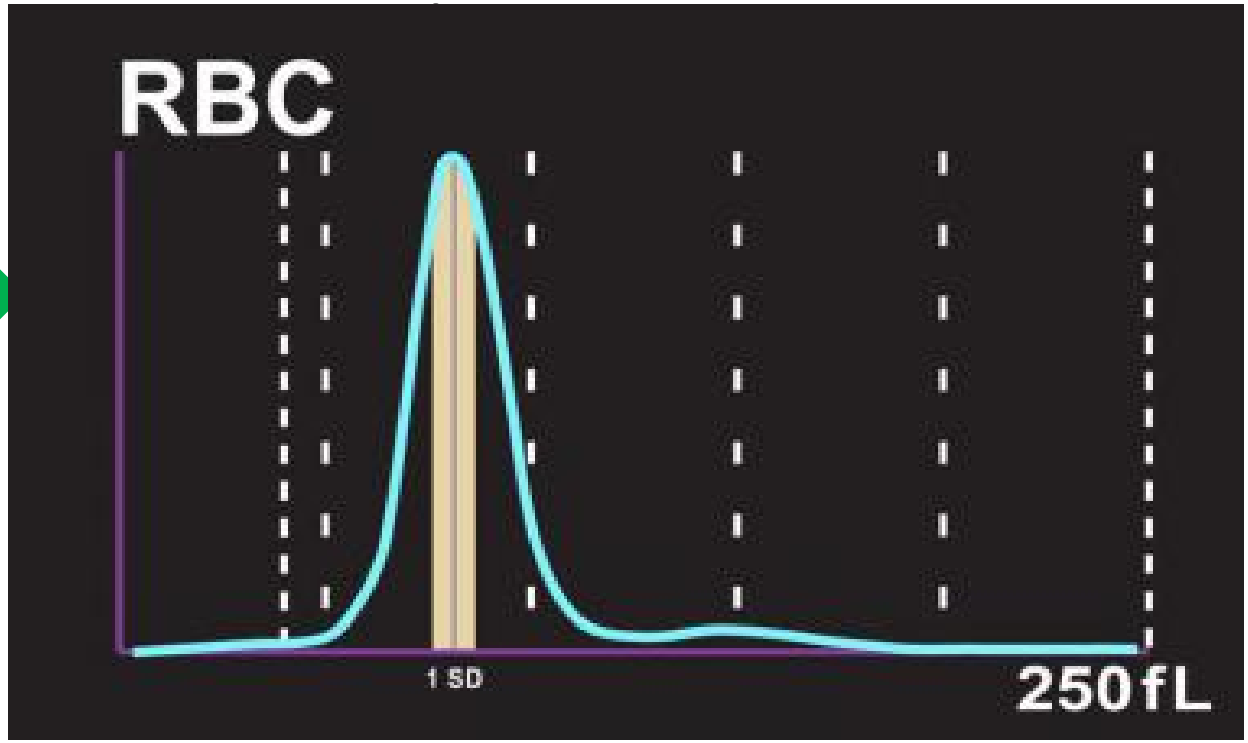


Mycoplasma Pneumonia

Hb	150 [g/L]	[130-180]
MCV	83.3 [fL]	[78-100]
Hct	43.8 [%]	[42-52]
RBC	5.1[10^6/uL]	[4.5-5.8]
MCH	29.7 [pg]	[27-33]
MCHC	48.1 [g/dL]	[33-36]



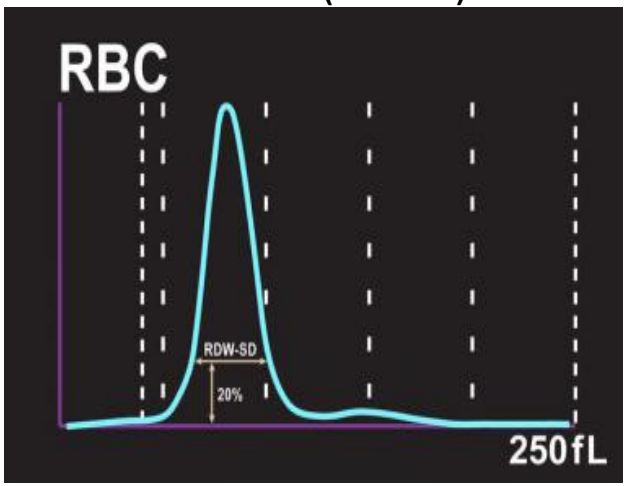




RDW-SD – Red Cell Distribution Width - Standard Deviation
- Actual measurement of the width of the RBC size distribution histogram
- 20% height level of the histogram

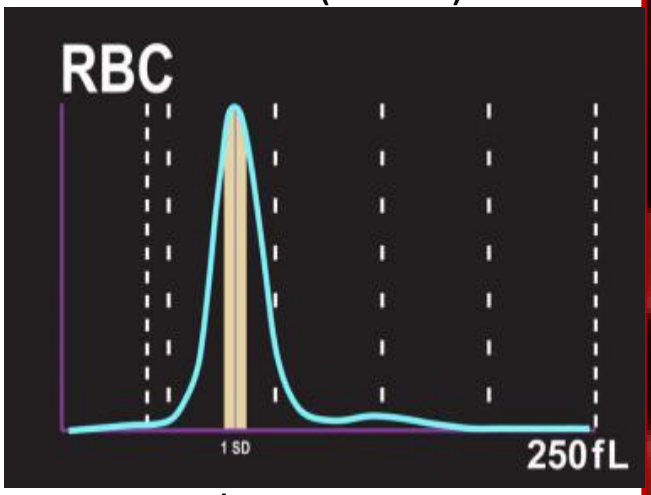
RDW-CV – Red Cell Distribution Width – Coefficient of Variation
- Calculated from standard deviation and MCV
- RDW-CV(%) = 1 SD of RBC volume / MCV x 100%
- Can be effected by MCV

RDW-SD (38.2fL)



Difference at 20% Height level

RDW-CV (12.8%)



1SD/MCV x 100%

RDW – Reflects Variation in RBC size and volume (Anisocytosis)

Elevated RDW – Early nutritional deficiency (Iron, B12, Folate)
- **Fragmentation**
- **Agglutination**
- **Dimorphic population**
- **Marked anisocytosis**

MCV

Normal RDW – Mild or no anisocytosis (Uncomplicated heterozygous thalassaemia)

Hb	112 [g/L]	[130-180]	- 112
MCV	68 [fL]	[78-100]	- 72
Hct	32.4[%]	[42-52]	- 30.2
RBC	4.8[10^6/uL]	[4.5-5.8]	- 3.3
MCH	25 [pg]	[27-33]	- 26
MCHC	28.8[g/dL]	[33-36]	- 26.8
RDW-SD	40 [fL]	[36.4-46.3]	- 48.4
RDW-CV	13 [%]	[11.6-14.0]	- 17.6
NRBC	-		
RET	108 [x10^6/L]	[40-100]	- 50
RET-He	33 [pg]	[28-36]	- 25
IRF	13.4[%]	[1.6-12.1]	- 6.5

Uncomplicated heterozygous thalassaemia

Iron deficiency anaemia

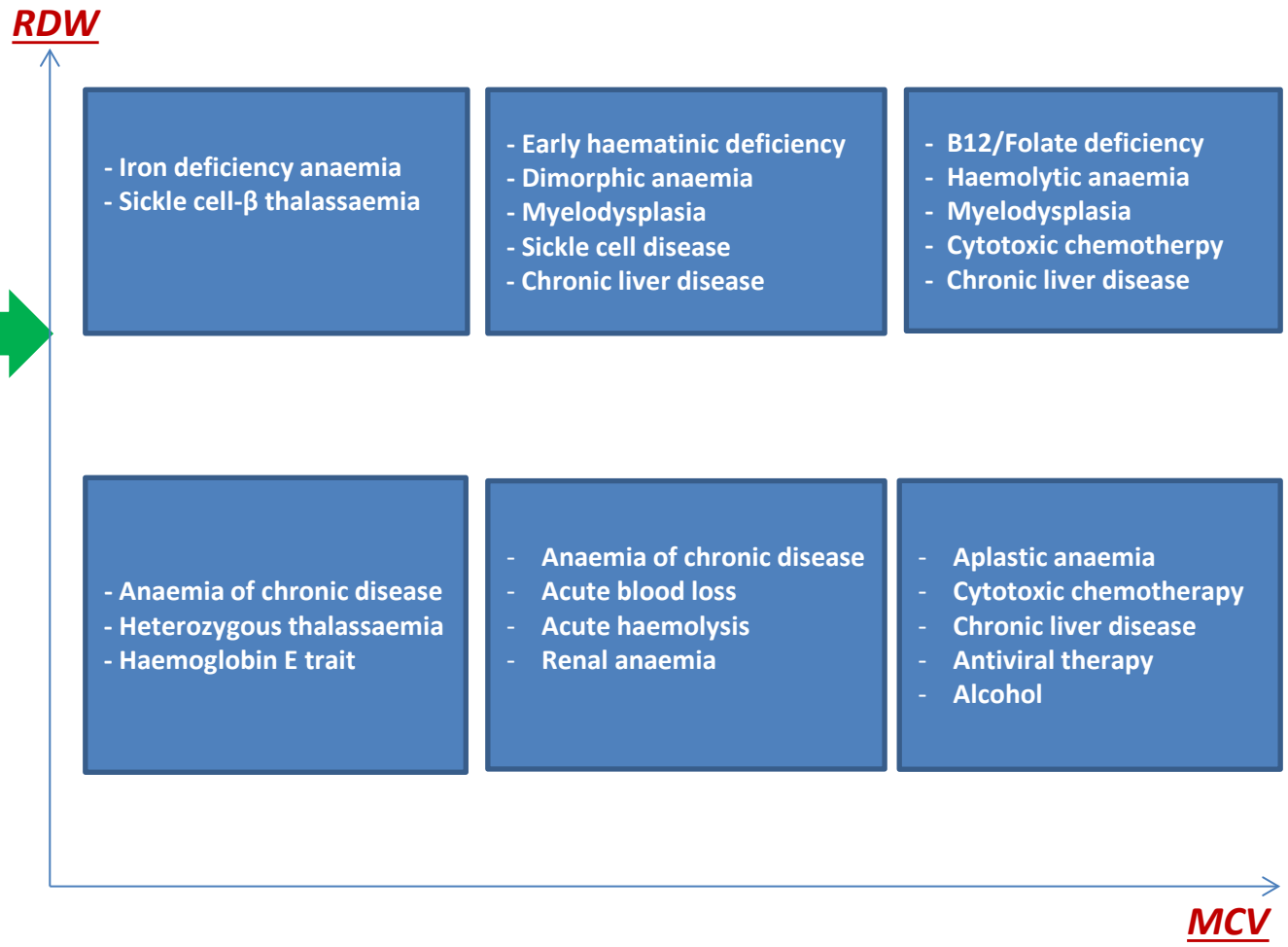
Hb	102 [g/L]	[130-180]	- 102
MCV	68 [fL]	[78-100]	- 72
Hct	32.4[%]	[42-52]	- 30.2
RBC	4.8[10^6/uL]	[4.5-5.8]	- 3.8
MCH	25 [pg]	[27-33]	- 26
MCHC	28.8[g/dL]	[33-36]	- 26.8
RDW-SD	42 [fL]	[36.4-46.3]	- 48.4
RDW-CV	17.6[%]	[11.6-14.0]	- 17.6
NRBC	-		
RET	108 [x10^6/L]	[40-100]	- 50
RET-He	33 [pg]	[28-36]	- 25
IRF	13.4[%]	[1.6-12.1]	- 6.5

RDW Index (RDWI):

MCV x RDW-CV / RBC

>220 Iron deficiency anaemia

<220 Thalassaemia trait



Hb	102 [g/L]	[130-180]	
MCV	83 [fL]	[78-100]	
Hct	32.4[%]	[42-52]	
RBC	3.2[10^6/uL]	[4.5-5.8]	
MCH	26 [pg]	[27-33]	
MCHC	28.8[g/L]	[33-36]	
RDW-SD	45 [fL]	[36.4-46.3]	
RDW-CV	14.6[%]	[11.6-14.0]	
NRBC	-		
RET	65 [x10^6/L]	[40-100]	
RET-He	23 [pg]	[28-36]	≈ CHr
IRF	3.8 [%]	[1.6-12.1]	

RET – Reticulocyte Count

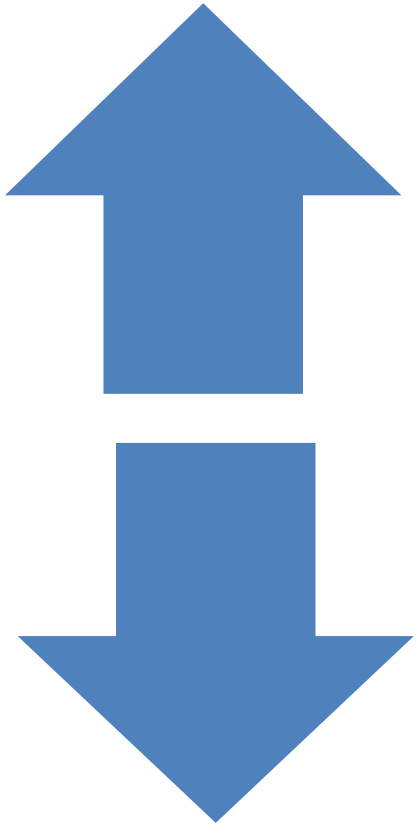
RET-He – Reticulocyte Haemoglobin Equivalent

CHr - Mean Reticulocyte Haemoglobin Content

IRF - Immature Reticulocyte Fraction

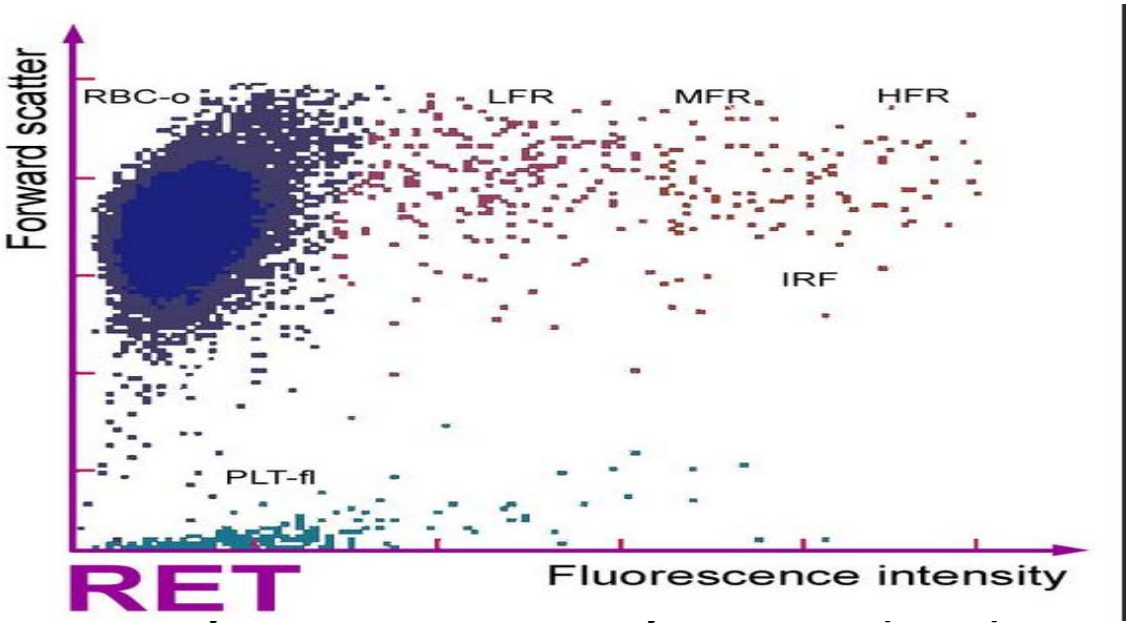
***Reticulocyte Count*:-**

- **Absolute Reticulocyte Count**
- **General - ↓ in production problem**
  - ↑in increased destruction
- **Results varies (e.g, stress marrow)**
- **Reticulocyte Production Index (RPI) / Corrected Reticulocyte Percentage – more reliable**



- Acute Blood Loss
- Acute Haemolysis
- Marrow response to therapy

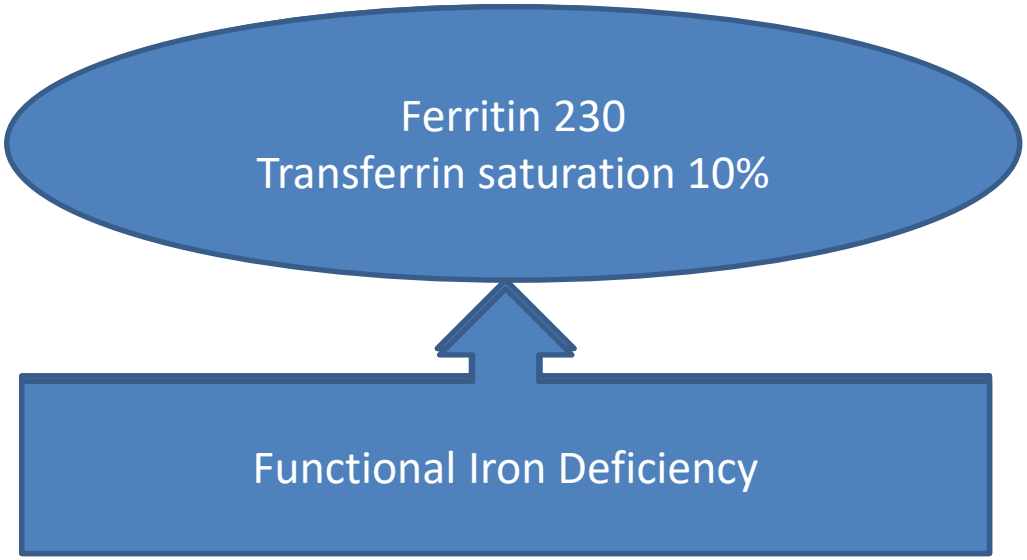
- Marrow Failure / Infiltration
- Haematinic deficiency
- Post chemo/radiation



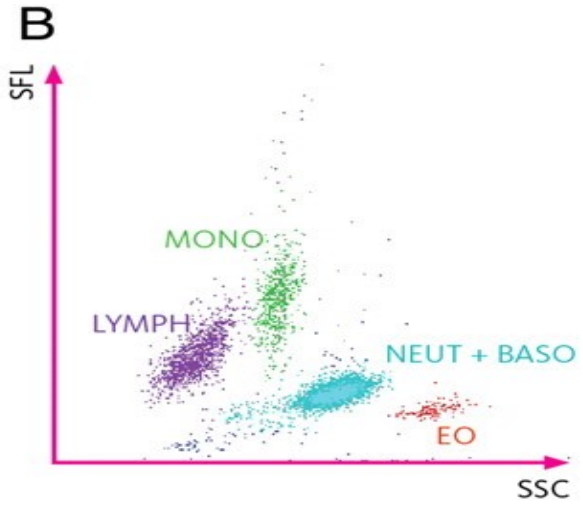
Immature Reticulocyte Fraction (IRF):-

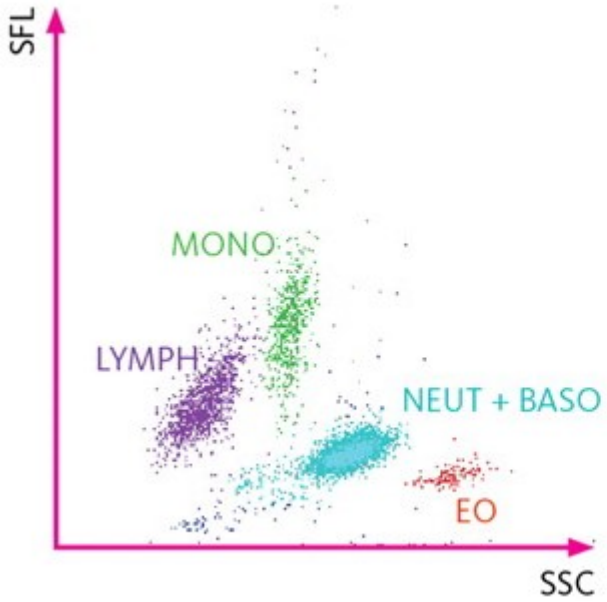
- **Quantitative measurement of RNA content of reticulocyte**
- (Low +) **Middle + High-florescence reticulocytes**
- **Useful assessment for evaluation of marrow recovery and to assess for effective erythropoiesis:**
  e.g - Post iv iron therapy
  - EPO response assessment

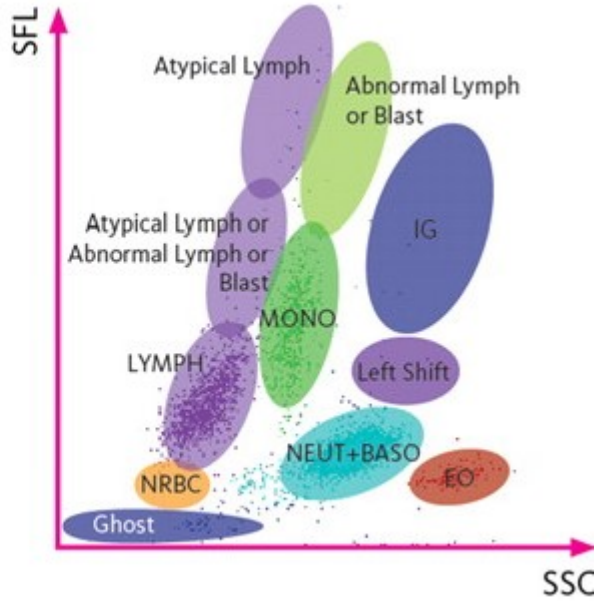
Hb	102 [g/L]	[130-180]	
MCV	83 [fL]	[78-100]	
Hct	32.4[%]	[42-52]	
RBC	3.2[10^6/uL]	[4.5-5.8]	
MCH	26 [pg]	[27-33]	
MCHC	28.8[g/dL]	[33-36]	
RDW-SD	45 [fL]	[36.4-46.3]	
RDW-CV	14.6[%]	[11.6-14.0]	
NRBC	-		
RET	65 [x10^6/L]	[40-100]	
RET-He	23 [pg]	[28-36]	↔ CHr
IRF	3.8 [%]	[1.6-12.1]	



Hb	125 [g/L]	[130-180]
MCV	97 [fL]	[78-100]
Hct	32.4[%]	[42-52]
WBC	22.8[10^6/uL]	[4.0-10.50]
Neu	18.6[10^6/uL]	[1.50-6.60]
Lym	2.1[10^6/uL]	[1.50-3.50]
Eosin	0.6[10^6/uL]	[0.00-0.50]
Baso	0.9[10^6/uL]	[0.00-0.08]
Mono	0.8[10^6/uL]	[0.05-0.10]
Platelet	450[10^6/uL]	[150-450]
MPV	8.7[fL]	[7.8-9.2]

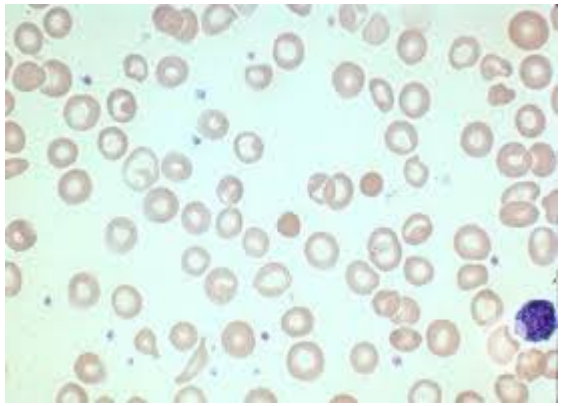




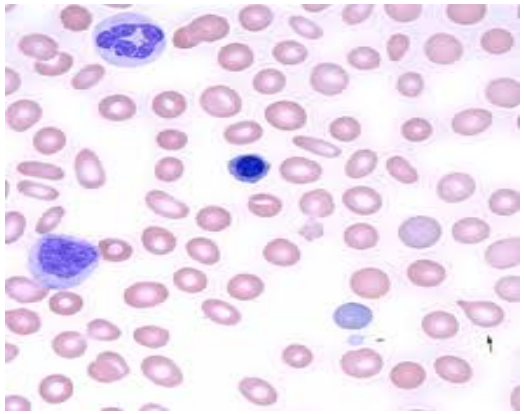


Hb	**125 [g/L]**	**[130-180]**
MCV	**97 [fL]**	**[78-100]**
Hct	**32.4[%]**	**[42-52]**
WBC	**22.8[10^6/uL]**	**[4.0-10.50]**
Neu	**18.6[10^6/uL]**	**[1.50-6.60]**
Lym	**2.1[10^6/uL]**	**[1.50-3.50]**
Eosin	**0.6[10^6/uL]**	**[0.00-0.50]**
Baso	**0.9[10^6/uL]**	**[0.00-0.08]**
Mono	**0.8[10^6/uL]**	**[0.05-0.10]**
Platelet	**450[10^6/uL]**	**[150-450]**
MPV	**8.7[fL]**	**[7.8-9.2]**

Hb	86 [g/L]	[130-180]
MCV	75 [fL]	[78-100]
Hct	24.4[%]	[42-52]
WBC	14.8[10^6/uL]	[4.0-10.50]
Neu	8.6[10^6/uL]	[1.50-6.60]
Lym	2.1[10^6/uL]	[1.50-3.50]
Eosin	0.1[10^6/uL]	[0.00-0.50]
Baso	0.1[10^6/uL]	[0.00-0.08]
Mono	0.1[10^6/uL]	[0.05-0.10]
Platelet	480[10^6/uL]	[150-450]
MPV	8.7[fL]	[7.8-9.2]

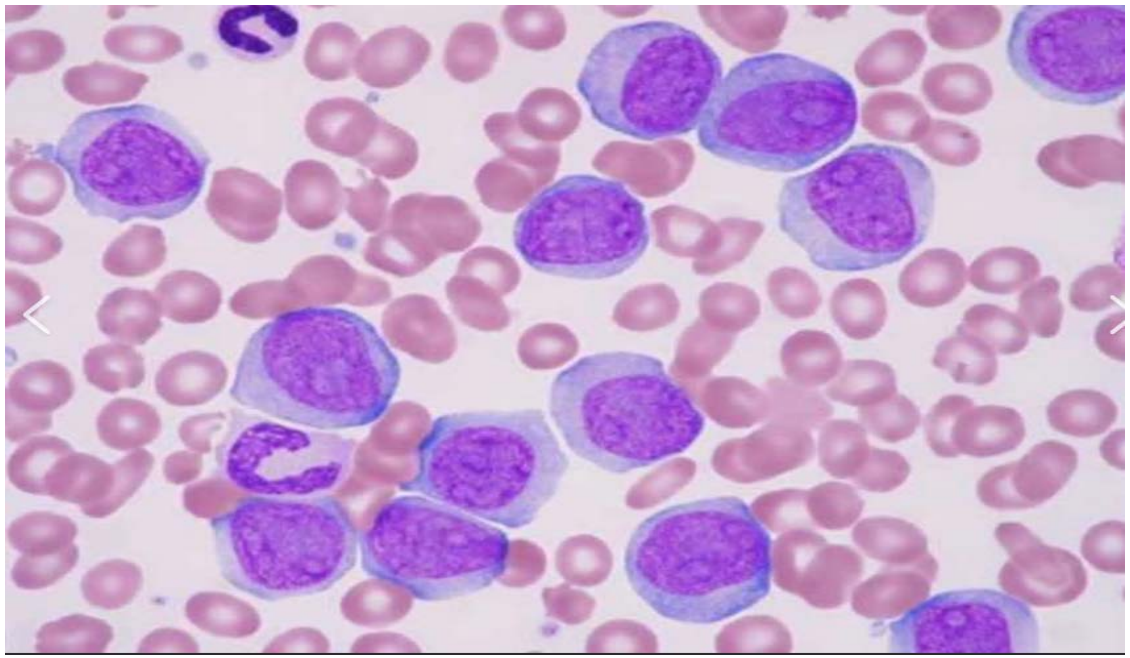


Iron deficiency anaemia

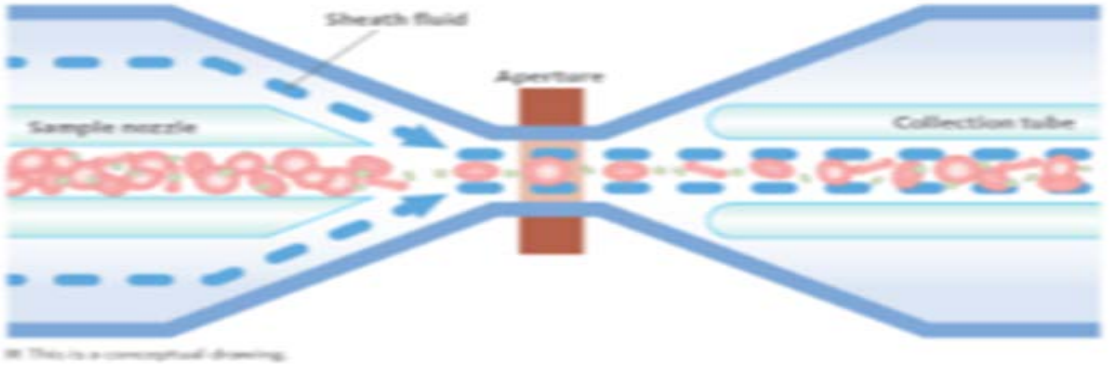


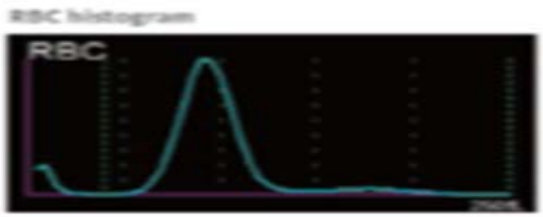
Myelofibrosis

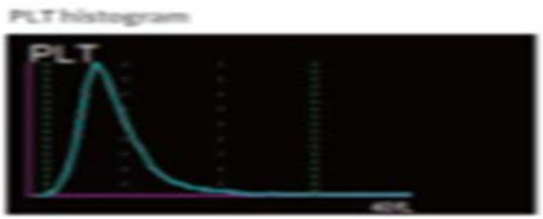
Hb	86 [g/L]	[130-180]
MCV	90 [fL]	[78-100]
Hct	24.4[%]	[42-52]
WBC	14.8[10^6/uL]	[4.0-10.50]
Neu	1.6[10^6/uL]	[1.50-6.60]
Lym	2.1[10^6/uL]	[1.50-3.50]
Eosin	0.1[10^6/uL]	[0.00-0.50]
Baso	0.1[10^6/uL]	[0.00-0.08]
Mono	10.6[10^6/uL]	[0.05-0.10]
Platelet	78 [10^6/uL]	[150-450]
MPV	8.7[fL]	[7.8-9.2]



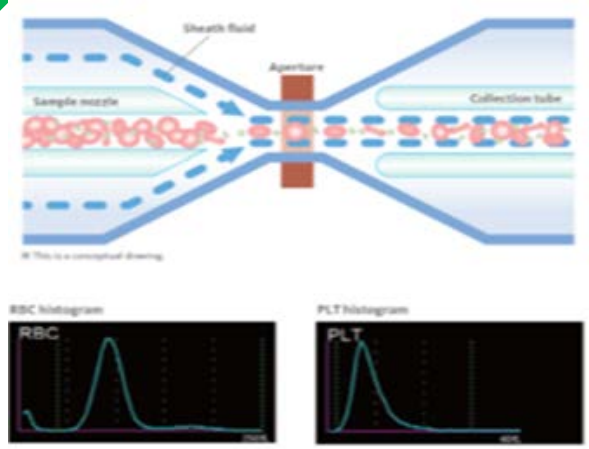
Hb	125 [g/L]	[130-180]
MCV	97 [fL]	[78-100]
Hct	32.4[%]	[42-52]
WBC	22.8[10^6/uL]	[4.0-10.50]
Neu	18.6[10^6/uL]	[1.50-6.60]
Lym	2.1[10^6/uL]	[1.50-3.50]
Eosin	0.6[10^6/uL]	[0.00-0.50]
Baso	0.9[10^6/uL]	[0.00-0.08]
Mono	0.8[10^6/uL]	[0.05-0.10]
Platelet	35 [10^6/uL]	[150-450]
MPV	8.5 [fL]	[7.8-9.2]



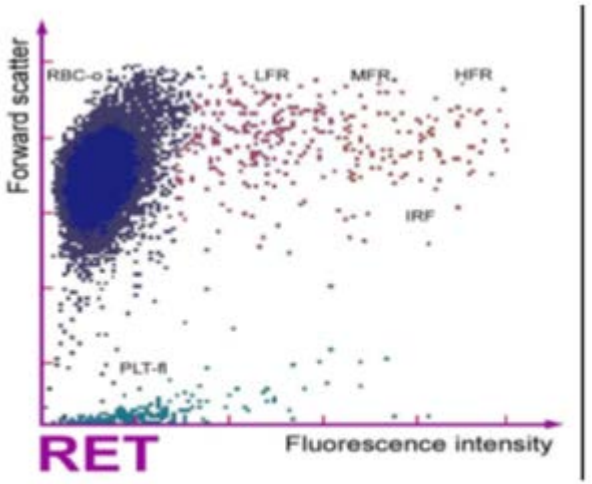




Hb	125 [g/L]	[130-180]
MCV	97 [fL]	[78-100]
Hct	32.4[%]	[42-52]
WBC	10.8[10^6/uL]	[4.0-10.50]
Neu	6.6[10^6/uL]	[1.50-6.60]
Lym	2.1[10^6/uL]	[1.50-3.50]
Eosin	0.2[10^6/uL]	[0.00-0.50]
Baso	0.0[10^6/uL]	[0.00-0.08]
Mono	0.7[10^6/uL]	[0.05-0.10]
Platelet	35 [10^6/uL]	[150-450]
MPV	11.8 [fL]	

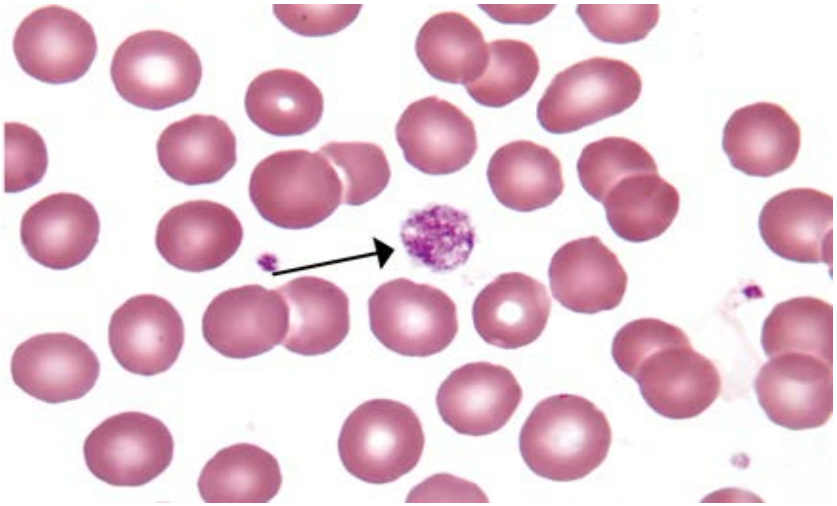


Impendence count



Optical count

Hb	125 [g/L]	[130-180]
MCV	97 [fL]	[78-100]
Hct	32.4[%]	[42-52]
WBC	10.8[10^6/uL]	[4.0-10.50]
Neu	6.6[10^6/uL]	[1.50-6.60]
Lym	2.1[10^6/uL]	[1.50-3.50]
Eosin	0.2[10^6/uL]	[0.00-0.50]
Baso	0.0[10^6/uL]	[0.00-0.08]
Mono	0.7[10^6/uL]	[0.05-0.10]
Platelet	35 [10^6/uL]	[150-450]
MPV	11.8 [fL]	[7.8-9.2]



Peripheral destruction

Hb	43.3 [g/L]	[130-180]
MCV	93.4 [fL]	[78-100]
Hct	28 [%]	[42-52]
WBC	721.x [10^6/uL]	[4.0-10.50]
Neu	4.24[10^6/uL]	[1.50-6.60]
Lym	676.x[10^6/uL]	[1.50-3.50]
Eosin	0.00[10^6/uL]	[0.00-0.50]
Baso	0.00[10^6/uL]	[0.00-0.08]
Mono	40.7[10^6/uL]	[0.05-0.10]
Platelet	133 [10^6/uL]	[150-450]
MPV	6.7[fL]	[7.8-9.2]

Any Comment?

SUMMARY:

1. Many information can be available from modern automated blood count report.
2. Each blood cells parameter is valuable in the approach of blood cells abnormality.
3. Correct diagnosis can be reached through the parallel information.
4. Understanding of laboratory principles and factors affecting the AUTOMATED results.
5. Importance of Quality Control System
6. One more important thing in the approach of anaemia

→ **Blood Film Morphology**


Thank You !!!